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PROPOSED

BEST DEMONSTRATED AVAILABLE TECHNOLOGY (BDAT) BACKGROUND DOCUMENT FOR AROMATICS AND OTHER HYDROCARBON U-WASTES

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1. INTRODUCTION

Pursuant to section 3004(m) of the Resource Conservation and Recovery Act (RCRA), enacted by the Hazardous and Solid Waste Amendments (HSWA) on November 8, 1984, the Environmental Protection Agency (EPA) is proposing best demonstrated available technology (BDAT) treatment standards for aromatics and other hydrocarbon U-wastes. Six waste codes are addressed: U019-benzene; U220-toluene; U239-xylenes; U055-cumene; U056-cyclohexane; and U186-pentadiene. These wastes are identified in 40 CFR Part 261.33 and listed in Tables 1-1 and 1-2 of this document. Compliance with these BDAT treatment standards when finalized will be a prerequisite for the placement of these wastes in facilities designated as land disposal units according to 40 CFR Part 268. The effective date for finalization of these treatment standards is May 8, 1990.

This background document provides the Agency's technical support and rationale for selecting and developing the proposed treatment standards for aromatics and other hydrocarbons. Section 2 presents waste-specific information, i.e., the industry affected and waste characterization. Section 3 discusses the applicable and demonstrated technologies used to treat the waste (or similar wastes), and Section 4 summarizes the available performance data, including data on which the treatment standards are based. Section 5 explains EPA's determination of BDAT, while Section 6 discusses the calculation of proposed BDAT treatment standards.

The BDAT program and promulgated methodology are more thoroughly described in two additional documents: Methodology for Developing Best Demonstrated Available Technology (BDAT) Treatment Standards (USEPA 1989c) and Generic Quality Assurance Project Plan for Land Disposal Restrictions Program ("BDAT") (USEPA 1987e). The petition process to be followed in requesting a variance from the BDAT treatment standards is also provided in the methodology document.

For the purpose of determining the applicability of the treatment standards, wastewaters are defined as wastes containing less than 1 percent (weight basis) total suspended solids* (TSS) and less than 1 percent (weight basis) total organic carbon (TOC). Wastes not meeting this definition must comply with the treatment standard for nonwastewaters.

The performance standards for aromatics and other hydrocarbon U-wastes (nonwastewaters and wastewaters) have been established based on a transfer of the treatment performance data for K001 (creosote) wastes and are based on the total concentration analysis of the ash and scrubber water residuals generated during incineration of K001 (creosote) waste. K001 treatment performance data were chosen because the Agency's methodology was to select the waste code (i.e., K001 (creosote)) with the highest detection limit from the waste code with the constituents of concern present in the untreated waste. The Agency believed that this was an appropriate methodology for the U-wastes because of the uncertainty in the concentration of the U-wastes. Also, EPA chose to use the highest detection limits because lower detection limits may not be consistently achievable.

Recently, additional wastewater treatment data primarily from EPA's Office of Water have been analyzed for the development of concentration-based treatment standards for many of the U and P wastes. These data include the treatment of wastewaters that are not specifically listed as U or P wastewaters, but do contain many of the corresponding U or P constituents. While these data were not available in time to incorporate into the preamble discussion or into this background document, these data

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* The term "total suspended solids" (TSS) clarifies EPA's previously used terminology of "total solids" and "filterable solids." Specifically, total suspended solids is measured by Method 209C, Total Suspended Solids Dried at 103 to 105°C, in Standard Methods for the Examination of Water and Wastewaters, 16th Edition (APHA, AWWA, and WPCF 1985).

are being placed in the administrative record for this third third rulemaking. Furthermore, the Agency has decided to propose alternative concentration-based treatment standards, based on the aforementioned data for all U and P wastewaters for which standards based on incinerator scrubber waters have been proposed. Further information on these alternative standards can be found in sections III.A.2.a.(3) and III.A.1.h.(b.) of the preamble for the proposed rule and in the document "Best Demonstrated Available Technology (BDAT) Background Document for Wastewaters Containing BDAT List Constituents" that can be found in the RCRA docket.

The Agency is also in the process of conducting wastewater treatment tests for selected U and P chemicals using wet air oxidation, powdered activated carbon treatment (PACT), and carbon adsorption. Since much of the currently available wastewater treatment data is from the treatment of relatively low concentrations of U and P constituents in industrial wastewaters, these tests have been designed to examine the applicability of treatment technologies to wastewaters containing relatively high concentrations of U and P constituents. The data developed in these studies will be placed in the administrative record for inspection and comment, when they become available. Further information on the availability of the forthcoming wastewater treatment test data can be found in section III.A.1.h.(6.) of the preamble for the proposed rule.

EPA is proposing a method of treatment for cumene (U055), cychohexane (U056) and 1,3-pentadiene (U186). The Agency does not believe that concentration-based standards can be established for the above mentioned wastes at this time. The major problem in establishing concentration-based standards for these wastes is that EPA does not currently have a verified SW-846 analytical method that can analyze for the concentrations of cumene (U055), cyclohexane (U056), or 1,3-pentadiene (U186) in treatment residues. As a result, a

concentration-based treatment standard for these waste codes is apparently not feasible and thus, the Agency is proposing a treatment standard of "Incineration as a Method of Treatment" for U055, U056, and U186 nonwastewaters. For U055, U056, and U186 wastewaters, EPA is proposing "Wet Air Oxidation or Chemical Oxidation followed by Carbon Adsorption; Biodegradation followed by Carbon Adsorption; or Incineration as a Method of Treatment." These wastewater technologies are appropriate for these constituents and have been demonstrated and/or promulgated for similiar U and P waste codes.

If the concentrations of the regulated constituents (for those constituents for which concentration-based standards are proposed, i.e., benzene, toluene, and xylenes), as generated or treated, are lower than or equal to the final BDAT treatment standard proposed in Tables 1-1 and 1-2, then the wastes are not prohibited from being placed in land disposal units.

Table 1-1 Proposed BDAT Treatment Standards for Aromatics and Other Hydrocarbon U-Wastes (Nonwastewaters)

Waste code	Regulated constituent	Maximum for any single grab sample total composition (mg/kg)
U019	Benzene	36
U220	Toluene	28
U239	Xylene(s) (total)[b]	33
		Method/technology proposed as BDAT
U055	Cumene	Incineration[a]
U056	Cyclohexane	Incineration[a]
U186	1,3-Pentadiene	Incineration[a]

[a]EPA is proposing a method of treatment rather than a concentration based standard because the Agency does not currently have a verified SW-846 analytical method that can analyze for these compounds at sufficiently low concentrations.

[b]The Agency is proposing one standard for xylenes in U239 which will represent the sum of the concentrations of o-xylene, m-xylene, and p-xylene present in the waste treatment residual. The basis of concentration numbers will therefore be the sum of the areas under all peaks identified as o-xylene, m-xylene or p-xylene in the chromatographic spectrum.

Table 1-2 Proposed BDAT Treatment Standards for Aromatics and Ohter Hydrocarbon U-Wastes (Wastewaters)*

Waste code	Regulated constituent	Maximum for any single grab sample total composition (mg/l)
U019	Benzene	0.033
U220	Toluene	0.028
U239	Xylene(s) (total)[b]	0.032

		Methods/technologies proposed as BDAT
U055	Cumene	Wet air oxidation or chemical oxidation followed by carbon adsorption; biodegradation followed by carbon adsorption; or incineration as methods of treatment[a]
U056	Cyclohexane	Wet air oxidation or chemical oxidation followed by carbon adsorption; biodegradation followed by carbon adsorption; or incineration as methods of treatment[a]
U186	1,3-Pentadiene	Wet air oxidation or chemical oxidation followed by carbon adsorption; biodegradation followed by carbon adsorption; or incineration as methods of treatment[a]

[a]EPA is proposing a method of treatment rather than a concentration based standard because the Agency does not currently have a verified SW-846 analytical method that can analyze for these compounds at sufficiently low concentrations.

[b]The Agency is proposing one standard for xylenes in U239 which will represent the sum of the concentrations of o-xylene, m-xylene, and p-xylene present in the waste treatment residual. The basis of concentration numbers will therefore be the sum of the areas under all peaks identified as o-xylene, m-xylene or p-xylene in the chromatographic spectrum.

*Note: Alternative standards for these U-wastes wastewaters are also proposed and are presented in section III.A.7. of the preamble for this Third Third rulemaking as standards for the corresponding chemicals in wastewater forms of multisource leachate.

2. INDUSTRY AFFECTED AND WASTE CHARACTERIZATION

This section describes the industry affected by the land disposal restrictions for the aromatics and other hydrocarbon U-wastes and presents available characterization data for these wastes. The aromatics and other hydrocarbon U-wastes being proposed for regulation are as follows (see Figure 2-1 for the chemical structures for these aromatics and other hydrocarbons):

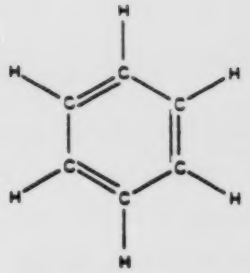
Waste Code	Constituent	CAS Number
U019	Benzene	71-43-2
U055	Cumene	98-82-8
U056	Cyclohexane	110-82-7
U186	1,3-Pentadiene	504-60-9
U220	Toluene	108-88-3
U239	Xylene(s)	1330-20-7

U-wastes include discarded commercial chemical products, manufacturing chemical intermediates or off-specification commercial chemical products, and spill residues, including contaminated water, soil, or debris, that are identified as toxic wastes. Because of the diversity of methods of waste generation, the composition of these wastes varies greatly. As a result, the constituents of concern may be present at concentrations varying from several parts per million to nearly the pure material.

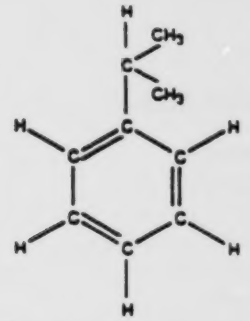
2.1 Industry Affected

Table 2-1 presents a summary of the known domestic manufacturing capacity for the aromatics and other hydrocarbons. The industry that may be most affected by regulation of aromatics and other hydrocarbon U-wastes is the organic chemical manufacturing industry (SIC codes 2865, 2869, 2899, 8071, and 5198). The degree to which an industry is affected

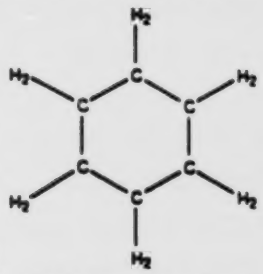
Figure 2-1
Chemical Structures for Aromatics and Other Hydrocarbon U- Wastes



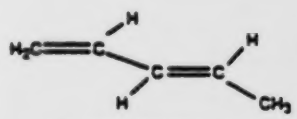
U019: Benzene



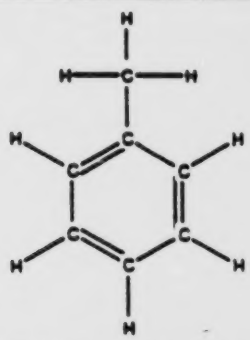
U055: Cumene (Isopropylbenzene)



U056: Cyclohexane

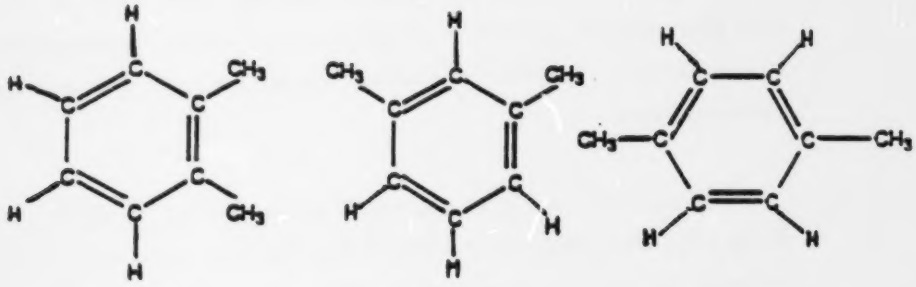


$CH_3CH{=}CHCH{=}CH_2$
U186: 1,3-PENTADIENE



U220: Toluene (methylbenzene)

Figure 2-1 (continued)



U239: Xylene(s)
ortho-Xylene, meta-Xylene and para-Xylene

is likely to be directly related to the degree to which the industry produces and/or uses the aromatics and other hydrocarbons listed in Table 1-1. Table 2-2 gives a summary of major uses for each aromatic and other hydrocarbons.

The Agency recently carried out a survey of RCRA treatment, storage, disposal, and recycling (TSDR) facilities regarding hazardous waste managed by the facilities in 1986. Information about 1986 volumes of aromatics and other hydrocarbon U-wastes has been extracted from the survey data base and is presented in Table 2-3. Because of the nature of the survey, the Agency believes it is likely that the actual 1986 volumes of aromatics and other hydrocarbon U-wastes may be understated in Table 2-3. The volumes shown in Table 2-3 are given in gallons; however, this should not be construed to mean that the hazardous wastes are necessarily in liquid form. The concentrations of the specific constituents in aromatics and other hydrocarbon U-wastes shown in Table 2-3 are not known, except that they are greater than zero. Table 2-4 presents the facilities (identified from review of the 1986 TSDR Survey) that may generate aromatics and other hydrocarbon U-wastes and identifies the States where these facilities are located.

2.2 Waste Characterization

Because of the extremely varied and numerous uses for the aromatic and other hydrocarbon U-wastes and because of the many ways that they may become hazardous wastes, characterization of aromatics and other hydrocarbon U-wastes is impractical. Benzene, toluene, and xylenes are volatile constituents on the BDAT list. Cumene, cyclohexane, and 1,3-pentadiene are not BDAT list constituents because EPA does not have a verified SW-846 analytical method that can analyze for these compounds at sufficiently low concentrations.

Table 2-5 lists the bond dissociation energy, boiling point, molecular weight, empirical formula, and solubility in water for each

U-waste listed in Table 1-1. The molecular weight of these compounds ranges between 68 and 120. There are many similarities among the aromatics and other hydrocarbons listed in Table 2-5.

Figure 2-1 presents the chemical structures for the aromatic and other hydrocarbon compounds. This group of chemicals, except for cyclohexane (U056) and 1,3-pentadiene (U186), all contain one benzene ring. Cumene (U055), toluene (U220), and xylenes (U234) consist of a benzene ring with aliphatic side chains. Cyclohexane (U056), a cycloalkane, has been included in this group because of its ability to be converted by catalytic reforming into aromatic hydrocarbons. Conversely, the addition of hydrogen (hydrogenation) to an aromatic compound yields cyclic aliphatic compounds, such as cyclohexane. 1,3-Pentadiene (U186) is a five-carbon chain with two conjugated double bonds (i.e., a diene) that provide a certain degree of aromaticity to the chemical, making it somewhat similar to the others in the aromatics and other hydrocarbons treatability group.

2.3 Treatability Group

Because of the similarities in the physical and chemical properties among these U-wastes, the Agency has categorized them as a single treatability group identified as aromatics and other hydrocarbons. That is, EPA believes that these wastes can be treated by the same technology to similar levels in the residue.

Table 2-1 1988 Domestic Manufacturing Capacity for Aromatics and Other Hydrocarbons

Code	Name	No. of manufacturers	Capacity (thousand ton/yr)
U019	Benzene	71	9,342
U055	Cumene (isopropylbenzene)	11	2,283
U056	Cyclohexane	9	2,038
U186	1,3-Pentadiene	3	NA
U220	Toluene	37	7,392
U239	Xylenes	42	9,898

NA - Not available.

Sources: SRI International, 1988.

Table 2-2 Principal Uses of Aromatics and Other Hydrocarbons

Waste code	Name	Uses
U019	Benzene	Manufacturing of styrenes, phenols, cyclohexanes, and other organic chemicals. Manufacture of medicinal chemicals, dyes, and many other organic compounds, artificial leather, linoleum, oil cloth, airplane dopes, varnishes, lacquers, detergents, pesticides; as solvent for waxes, resins, oils, etc. Destroys screwworm larvae in wounds.
U055	Cumene (Isopropylbenzene)	In manufacture of phenol, acetone, acetophenone, a-methylstyrene.
U056	Cyclohexane	Solvent for lacquers and resins. Paint and varnish remover. In extraction of essential oils. In analytical chemistry for molecular weight determinations. In manufacture of adipic acid, benzene, cyclohexyl chloride, nitrocyclohexane, cyclohexanol, and cyclohexanone. In manufacture of solid fuel for camp stoves. In fungicidal formulations (possesses slight fungicidal action). In industrial recrystallization of steriods.
U186	1,3-Pentadiene	In manufacture of synthetic rubber.
U220	Toluene	In manufacture of benzoic acid, benzaldehyde, explosives, dyes, caprolactam, saccharin, medicines, and perfumes; as an adhesive solvent in plastic toys and model airplanes; as a solvent for paints, lacquers, gums, and resins; in the extraction of various principals from plants; as a gasoline additive.

Table 2-2 (continued)

Waste code	Name	Uses
U239	Xylenes	As a solvent; as raw material for production of benzoic acid, phthalic anhydride, and isophthalic and terephthalic acids as well as their dimethyl esters used in the manufacture of polyester fibers; manufacturing dyes and other organics; sterilizing catgut; with Canada balsam as oil-immersion in microscopy; as a cleaning agent in microscope techniques.

Source: Merck Index 1983 Encyclopedia of Chemical Technology, 3rd Edition, 1984.

Table 2-3 Estimated Number of Facilities and Volume of Aromatics and Other Hydrocarbon U-Wastes Handled in 1986

Waste	Name	No. of generators	Volume (gal)
U019	Benzene	23	1,555,012
U055	Cumene (isopropylbenzene)	5	364
U056	Cyclohexane	10	1,394,490
U186	1,3-Pentadiene	NA	NA
U220	Toluene	48	261,492
U239	Xylenes	37	15,082

NA - Not available.

Source: USEPA 1986a.

Table 2-4 Facilities That May Generate
Aromatics and Other Hydrocarbon U-Wastes

Waste code	Description	Facility name	State	Quantity generated
U019	Benzene	TVA National Fertilizer	AL	2G
		Monsanto Company	AL	330G
		E.I. Dupont Experimental Station	DE	12P
		Argonne National Laboratory	IL	55G
		Shell Oil Company	IL	5T
		3M Company Chemolite Center	MN	5T
		Resource Recovery Center	MO	1T
		University of Missouri	MO	NA
		National Institute Environmental Health Sciences South	NC	2G
		Cosan Chemical Corporation	NJ	1T
		Standard Oil Company	OH	5G
		Oregon Regional	OR	62G
		Squibb Pharmaceutical Complex	PR	6G
		USDOE Savannah River	SC	20G
		USDOE Ridge National Laboratory	TN	164G
		University of Texas Medical Branch	TX	33G
		Celanese Chemical Company, Inc.	TX	6,462T
		Hoechst Celanese Corporation	TX	15G
		Intercontinental Terminals	TX	1T
		US Navy Norfolk Naval Base	VA	1T
		US Navy Surface Weapons	VA	1G
		USDOE	WA	1P
		Aldrich Chemical Company	WI	75G
U055	Cumene (isopropyl benzene)	E.I. DuPont Experimental Station	DE	26P
		PPG Industries, Inc. R&D	PA	0.5T
		Allied Corp.	PA	1T
		USDOE	WA	1P
		Aldrich Chemical Company, Inc.	WI	1G
U056	Cyclohexane	E.I. DuPont Experimental Station	DE	18P
		Resource Recovery Center	MO	1T
		National Institute of Environmental Health Sciences South	NC	1G
		Shell Chemical Company	OH	5,809T[a]
		Monsanto Company	OH	0.5T
		Standard Oil Company	OH	2G

Table 2-4 (continued)

Waste code	Description	Facility name	State	Quantity generated
U056	(continued)	Squibb Pharmaceutical Complex	PR	9G
		Hoechst Celanese	TX	15G
		USDOE	WA	7P
		Aldrich Chemical Company, Inc.	WI	1T
U186	1,3-Penta-diene	NA	NA	NA
U220	Toluene (methyl benzene)	US Army Fort Richardson	AK	8G
		University of South Alabama	AL	1T
		USAF Sans-Monthan Air Force	AZ	60G
		University of Arizona	AZ	0.2T
		E.I. DuPont deNemours	CA	16T[a]
		Shell Oil Company	CA	48T
		Vanderbilt Chemical Corporation	CT	3T
		E.I. DuPont Experimental Station	DE	25P
		US Naval Air Station	FL	1T
		NASA JFK Space Center	FL	1T
		Nipro, Inc.	GA	118,222G
		Argonne National Laboratory	IL	205G
		Dana Corporation	IL	2T
		Borg-Warner	IL	1,072.5G
		Rohm & Haas	KY	2T
		Cecos International	LA	36T
		Dow Chemical Company	LA	71T
		Ciba-Geigy	LA	46T
		Olin Corporation	MA	55G
		Clean Harbors of Braintree	MA	NA
		Watkins Johnson	MO	1,207G
		Monsanto JF Queeny Plant	MO	26T
		Alcolas, Inc.	MO	65T
		Chevron USA	MS	86G
		National Institute Environmental Health Sciences South	NC	105G
		GAF Corporation	NJ	10G
		USDOE Sandia National Laboratory	NM	50G
		Occidental Chemical Corporation	NY	11T
		Schenectady Chemical, Inc.	NY	1T
		USEPA T&E Facility	OH	1T
		Standard Oil Company	OH	17G[a]
		Oregon Regional Primate	OR	317G
		US Army New Cumberland	PA	13G

Table 2-4 (continued)

Waste code	Description	Facility name	State	Quantity generated
U220	(continued)	PPG Industries, Inc.	PA	2T
		Squibb Pharmaceutical Company	PR	5G
		US Navy Charleston Naval	SC	2T[a]
		USDOE Savannah River Plant	SC	220G
		Pantex Plant Amarillo Area	TX	2,750G
		University of Texas Medical Branch	TX	11G
		Dow Chemical Company	TX	0.5T
		Phillips 66 Company	TX	1,175G
		Voda Petroleum Company	TX	110G
		Hoechst Celanese	TX	100G
		Cecos Int.	TX	115T[a]
		US Navy Norfolk Naval Base	VA	1T
		USDOE	WA	356P
		Paragon Electric Company	WI	9T
		Aldrich Chemical Company	WI	104.5T
U239	Xylenes (dimethyl benzenes)	Ciba-Geigy	AL	15P
		University of South Alabama	AL	1T
		Morton Thiokol	CA	6T
		Shell Oil Company	CA	1T
		Teledyne McCormick	CA	50G
		National Semiconductor	CA	6.5T
		USDOE Rocky Flats	CO	1G
		Vanderbilt Chemical Corporation	CT	1T
		E.I. DuPont	DE	33P
		US Naval Air Station	FL	1T
		USAF Homestead Air Force Base	FL	137G
		Argonne National Laboratory	IL	18.3G
		Ciba-Geigy	LA	6T
		Martin Marietta Michoud Aerospace	LA	1T
		Clean Harbors of Braintree	MA	165G
		Monsanto	MO	7T
		National Institute Environmental Health Sciences South	NC	145G
		US Army Training Center	NJ	136G
		GAF Corporation	NJ	50G
		Staflix Specialty Ester	NJ	1,815G
		USDOE Sandia National Laboratory	MN	1G
		USDOE Brookhaven National Laboratory	NY	1G
		Occidental Chemical	NY	4T

Table 2-4 (continued)

Waste code	Description	Facility name	State	Quantity generated
U239	(continued)	Schenectady Chemical	NY	9T
		Harshaw Chemical Company	OH	1T
		Standard Oil Company	OH	7G
		Nela Park Facility	OH	1P
		Oregon Regional Primate	OR	53G
		US Army Letterkenny Army Depot	PA	34G
		Merck Sharp and Dohme	PA	634G
		Squibb Pharmaceutical Complex	PR	1G
		US Navy Charlestor Naval Shipyard	SC	1T
		North Hand Protection	SC	1T
		Hoechst Celanese	TX	150G
		US Navy Norfolk Naval Base	VA	1T
		US Navy Puget Sound Naval Shipyard	WA	1T
		USDOE	WA	361P

T - Tons; P - Pounds; G - Gallons.

NA - Not available.

[a] - Mixed waste.

Source: USEPA 1986a.

Table 2-5 Some Physical and Chemical Characteristics of Aromatics and Other Hydrocarbons

Waste code	Name	Chemical formula	Bond dissociation energy (Kcal/mole)[a]	Molecular weight	Boiling Point(°C)[b]	Solubility in water, (mg/l at 25°C)[b]
U019	Benzene	C_6H_6	1,335	78	80.1	1,780
U055	Cumene	C_8H_{12}	2,190	120	153	50
U056	Cyclohexane	C_6H_{12}	1,710	84	81	55
U186	1,3-Pentadiene	C_5H_8	1,260	68	42	870
U220	Toluene	C_7H_8	1,620	92	110.6	515
U239	Xylene(s)	C_8H_{10}	1,905	106	137-140	175

[a] Sanderson 1971.

[b] USEPA 1985.

3. APPLICABLE AND DEMONSTRATED TREATMENT TECHNOLOGIES

This section identifies the treatment technologies that are applicable to the group of aromatics and other hydrocarbon U-wastes and determines which, if any, of the applicable technologies can be considered demonstrated for the purpose of establishing BDAT.

To be applicable, a technology must be theoretically usable to treat the waste in question, or to treat a waste that is similar in terms of the parameters that affect treatment selection. (For detailed descriptions of the technologies applicable for these wastes, or for wastes judged to be similar, see EPA's Treatment Technology Background Document (USEPA 1988q).) To be demonstrated, the technology must be used in full-scale operation for the treatment of the waste in question or a similar waste. Technologies that are available only at research facilities or at pilot- and bench-scale operations are not considered in identifying demonstrated technologies.

3.1 Applicable Treatment Technologies

The following subsections present applicable treatment technologies for aromatics and other hydrocarbon U-wastes (nonwastewaters and wastewaters).

3.1.1 Nonwastewaters

Applicable treatment technologies include those that destroy or reduce the total amount of organic compounds in the waste since nonwastewater forms of these wastes contain hazardous organic constituents at treatable concentrations. The Agency has identified the following treatment technologies as applicable for these wastes: (1) incineration (fluidized bed, rotary kiln, and liquid injection); (2) solvent extraction followed by incineration or recycle of the extract and/or raffinate (residual); (3) critical fluid extraction followed by

incineration; (4) wet air oxidation; (5) chemical oxidation; and (6) distillation. Total recycle or reuse may also be applicable for certain wastes such as off-specification commercial chemical products. These treatment technologies were identified based on current waste treatment practices and engineering judgment.

Application of these technologies is dependent upon the physical and chemical form of the waste. Many of the wastes may be generated in a variety of forms as noted in Section 2. For example, a contaminated soil may be amenable to rotary kiln incineration, while an off-specification liquid chemical product may be amenable to solvent extraction.

(1) Incineration. Incineration is a destruction technology in which energy, in the form of heat, is transferred to the waste to destabilize chemical bonds and destroy hazardous organic constituents. In a fluidized bed incinerator, waste is injected into the fluidized bed material (generally sand and/or incinerator ash), where it is heated to its ignition temperature. Heat energy from the combustion reactions is then transferred back to the fluidized bed. Ash is removed periodically during operation and during bed change-outs.

In a rotary kiln incinerator, wastes are fed into the elevated end of the kiln, and the rotation of the kiln mixes the waste with hot gases to heat the waste to its ignition temperature. Ash is removed from the lower end of the kiln. Combustion gases from the kiln enter the afterburner for complete destruction of gaseous waste constituents. Other wastes may also be injected into the afterburner.

In a liquid injection incinerator, liquid wastes are atomized and injected into the incinerator. In general, only wastes with low or negligible ash content are amenable to liquid injection incineration. Therefore, this technology generally does not result in the generation of an ash residual.

Combustion gases from the incinerator are then fed to a scrubber system for cooling and removal of entrained particulates and acid gases, if present. In general, with the exception of liquid injection incineration, two residuals are generated by incineration processes: ash and scrubber water.

(2) Solvent extraction. Solvent extraction is a separation technology whereby a contaminant dissolved in a liquid waste is transferred from the waste to an extracting solvent that dissolves the contaminant. For solvent extraction to be effective, the extracting solvent must not be significantly miscible in the waste to be treated and must differ in density so that phase separation is possible. This technology results in the generation of two residuals: a treated waste residual (raffinate) and an extract. The extract and/or raffinate may be recycled or treated by incineration.

(3) Critical fluid extraction. Critical fluid extraction is a solvent extraction technology in which the solvent, which is generally liquified gas at or beyond its critical state, is used to extract hazardous organic constituents from the wastes in the same way as solvent extraction above. After the extraction step, the solvent is brought back to its normal (ambient pressure) condition in the gaseous state, generating a small volume of extract that is concentrated in hazardous organic constituents. This technology results in the generation of two residuals: a treated waste residual (raffinate) and an extract. The extract may be recycled or treated by incineration; the raffinate can usually be incinerated.

(4) Wet air oxidation. Wet air oxidation is a destruction technology in which hazardous organic constituents in wastes are oxidized and destroyed under pressure at elevated temperatures in the presence of dissolved oxygen. This technology is applicable for wastes composed primarily of water and having up to 10 percent total organic concentration. Wet air oxidation results in the formation of one

treatment residual: treated effluent. The treated effluent may require further treatment for hazardous and nonhazardous organic constituents by biological treatment and/or carbon adsorption or other wastewater treatment technologies.

(5) Chemical oxidation. Chemical oxidation is a treatment technology that may be used to treat wastes containing organics and in some cases to treat sulfide and cyanide wastes. The basic principle of chemical oxidation is that some dissolved organic compounds, inorganic cyanides, and sulfides are chemically oxidized to yield carbon dioxide, water, salts, simple organic acids, and, in the case of sulfides, sulfates. The principal chemical oxidants used are hypochlorite, chlorine gas, chlorine dioxide, hydrogen peroxide, ozone, and potassium permanganate.

(6) Distillation. Distillation is the vaporization of one or more volatile components out of liquid solution by the application of heat. Individual components vaporize in order of their volatility so that relatively pure products result upon condensation of the volatilized components. Organic products that were volatilized are typically purified and recovered. Nonvolatile residues of less volatile components remain behind in the distillation vessel bottoms. These bottoms are typically incinerated.

(7) Total recycle or reuse. Total recycle or reuse of a waste in the same process from which it originated, or another process, eliminates the generation of the waste and ideally generates no treatment residuals.

3.1.2 Wastewaters

Applicable technologies include those that destroy or reduce the total amount of organic compounds in the waste since wastewater forms of the aromatics and other hydrocarbon U-wastes will likely contain hazardous organic constituents at treatable concentrations. The Agency has identified the following treatment technologies as potentially applicable for treatment of organic wastewaters: (1) incineration, (2) wet air oxidation, (3) chemical oxidation, (4) biological treatment, (5) carbon adsorption, (6) solvent extraction, (7) distillation, and (8) steam stripping. Total recycle or reuse may also be applicable for certain wastewaters. These treatment technologies were identified based on current waste treatment practices and engineering judgment.

Application of these technologies is often dependent upon the concentrations and type(s) of waste constituents present in the waste. Carbon adsorption, for example, is often used as a polishing step following primary treatment by biological treatment, solvent extraction, or wet air oxidation. Typically, carbon adsorption is applicable for treatment of wastewaters containing less than 0.1 percent total organic concentration, while wet air oxidation, chemical oxidation, biological treatment, and solvent extraction are applicable for treatment of wastewaters containing up to 1 percent total organic concentration.

(1) Incineration. Incineration of wastewaters is identical to that of nonwastewaters as described previously in Section 3.1.1. EPA believes that incineration may be an applicable wastewater technology for aromatics and other hydrocarbon U-wastes because incineration typically provides significant destruction (even for wastewaters) and that some of

these wastewaters may actually contain high concentrations (near 1 percent total organic carbon (TOC)) of carbon. Furthermore, commenters to the Second Third proposed rule indicated that they, indeed, were incinerating many wastewaters and they did not want to be precluded from doing so where EPA had proposed only carbon adsorption as a method of treatment for wastewater forms of certain U and P organo-phosphorous pesticides.

(2) Wet air oxidation. Wet air oxidation of wastewaters is identical to that of nonwastewaters as described previously in Section 3.1.1.

(3) Chemical oxidation. Chemical oxidation of wastewater is identical to that of nonwastewaters as described previously in Section 3.1.1.

(4) Biological treatment. Biological treatment is a technology that uses living microorganisms to decompose organic constituents. Biological treatment can occur either in the presence of oxygen, known as aerobic treatment, or in the absence of oxygen, know as anaerobic treatment. In aerobic treatment the organic constituents are broken down into water, carbon dioxide, and lower molecular weight organic components by the microorganisms. In contrast, in anaerobic treatment, the organic constituents are broken down into water, methane and other organic components.

(5) Carbon adsorption. Carbon adsorption is a separation technology in which hazardous organic constituents in wastewaters are selectively adsorbed onto activated carbon. This technology results in the formation of two treatment residuals: a treated effluent and spent activated carbon. The spent activated carbon usually requires additional treatment, such as incineration.

(6) **Distillation**. Distillation of wastewaters is identical to that of nonwastewaters as described previously in Section 3.1.1

(7) **Solvent extraction**. Solvent extraction of wastewaters is identical to that of nonwastewaters as described previously in Section 3.1.1.

(8) **Steam stripping**. Steam stripping is a technology that can separate more volatile materials from less volatile materials by vaporizing the more volatile materials and then condensing them. As such, it is a type of the distillation process.

(9) **Total recycle or reuse**. Total recycle or reuse of wastewaters is identical to that of nonwastewaters as described previously in Section 3.1.1.

3.2 Demonstrated Treatment Technologies

The following subsections present demonstrated treatment technologies for aromatics and other hydrocarbon U-waste nonwastewaters and wastewaters.

3.2.1 Nonwastewaters

The Agency has identified incineration as a demonstrated technology for treatment of nonwastewater forms of aromatics and other hydrocarbon U-wastes. Incineration is demonstrated on a full-scale operational basis for treatment of several of these nonwastewaters as determined from review of the data from many of the treaters of such wastes identified in the 1986 TSDR Survey. For the land disposal restrictions program Third Third scheduled wastes, the Agency tested rotary kiln incineration for treatment of toluene (U220) (nonwastewater).

From review of the 1986 TSDR Survey and the USEPA's Water Engineering Research Laboratory (WERL) data base, the Agency determined that some facilities also treat nonwastewater forms of these wastes or wastes judged to be similar on a full-scale operational basis using wet air oxidation, chemical oxidation, and distillation; therefore, EPA believes that these technologies are also demonstrated (being used on a full-scale basis) for these wastes. Since facilities using solvent extraction, critical fluid extraction or total recycle or reuse were not identified, EPA believes that critical fluid extraction, solvent extraction, and total recycle or reuse are not currently demonstrated for these wastes.

3.2.2 Wastewaters

From review of the 1986 TSDR Survey and the USEPA's Water Engineering Research Laboratory data base, the Agency has determined that some facilities treat U019 (benzene), U055 (Cumene), U056 (cyclohexane), U186 (1-3 pentadiene), U220, and U239 (xylenes) wastewater forms of these wastes using incineration, biological treatment, carbon adsorption, wet air oxidation, chemical oxidation, distillation, and steam stripping. Therefore, EPA believes that these technologies are demonstrated for the aromatics and other hydrocarbon U-wastes. Since facilities using critical fluid extraction, solvent recovery and total recycle/reuse were not identified, the Agency believes that these technologies are not demonstrated for the aromatics and other hydrocarbon U-wastes.

4. PERFORMANCE DATA BASE

This section presents the data available on the performance of the demonstrated technologies in treating the listed wastes (identified in Tables 1-1 and 1-2). These data are used elsewhere in this document for determining which technologies represent BDAT (Section 5) and for developing proposed treatment standards (Section 6). Eligible data may include data developed at research facilities, or through other applications at less than full-scale operation, as long as the technology is demonstrated in full-scale operation for the similar waste or wastes as defined in Section 3.2.

Performance data for the aromatics and other hydrocarbon U-wastes include the untreated waste and treated waste concentrations for each constituent, the values of operating parameters that were measured at the time the waste was being treated, and the values of relevant design parameters for the treatment technology. Note that these data are for constituents of concern present in F and K wastes and not U-wastes per se. The Agency believes that U-wastes may be similar to F and K wastes, therefore, EPA believes it is valid to use the performance data from F and K waste to develop the U-waste standards.

Where data are not available on the treatment of the specific wastes of concern, the Agency may elect to transfer performance from the treatment of a similar waste or wastes, using the demonstrated technology. EPA's methodology for the transfer of treatment performance data is provided in EPA's Methodology for Developing BDAT Treatment Standards. To transfer data from another waste category, EPA must find that the wastes covered by this background document are no more difficult to treat (based on the waste characteristics that affect performance of the demonstrated treatment technology) than the treated wastes from which performance data are transferred.

In developing the treatment standards for the aromatics and other hydrocarbons, the Agency reviewed the treatability and detection limit data from several different incineration test burns conducted by EPA for various F and K wastes. These data represent a myriad of different hazardous wastes that were generated and treated at several different incineration facilities. (Detection limits data from these various test burns are included in Appendix A of this background document.)

4.1 Nonwastewaters

The Agency determined that there were substantial treatment data for benzene (U019), toluene (U220), and xylenes (U239) of the nonhalogenated aromatic constituents from the incineration of ten tested waste codes: K001 (bottom sediment sludge from the treatment of wastewaters from wood preserving processes that use creosote and/or pentachlorophenol); K011 (bottom stream from the wastewater stripper in the production of acrylonitrile); K013 (bottom stream from the acetonitrile column in the production of acrylonitrile); K014 (bottoms from the acetonitrile purification column in the production of acrylonitrile); K037 (wastewater treatment sludges from the production of disulfoton); K048 (dissolved air flotation (DAF) float from the petroleum refining industry); K051 (API separator sludge from the petroleum refining industry); K087 (decanter tank tar sludge from coking operations); K101 (distillation tar residues from the distillation of aniline-based compounds in the production of veterinary pharmaceuticals from arsenic or organo-arsenic compounds); and K102 (residue from the use of activated carbon for decolorization in the production of veterinary pharmaceuticals from arsenic or organo-arsenic compounds) wastes.

The Agency also has performance data for incineration of toluene (U220) from a June 1989 test burn. Treatment standards for K001, K037, K048, K051, K087, K101, and K102 were promulgated in the First Third final rule on August 8, 1988. EPA promulgated treatment standards for K011, K013, and K014 in the Second Third final rule on June 8, 1989.

Data from these above-mentioned test burns included performance data/detection limits for benzene, toluene, and xylenes ranging from 0.010 to 10.0 ppm for benzene, 0.005 to 10.0 ppm for toluene, and 0.002 to 10.0 ppm for xylenes (see Appendix A). The Agency believes that these treatment data provide a sufficient range of concentration of aromatics and other hydrocarbon U-waste constituents in untreated wastes and in various nonwastewater matrices to be considered representative of all aromatics and other hydrocarbon U-wastes.

4.2 Wastewaters

Recently, additional wastewater treatment data primarily from EPA's Office of Water have been analyzed for the development of concentration-based treatment standards for many of the U and P wastes. These data include the treatment of wastewaters that are not specifically listed as U or P wastewaters, but do contain many of the corresponding U or P constituents. While these data were not available in time to incorporate into the preamble discussion or into this background document, these data are being placed in the administrative record for this Third Third rulemaking. Furthermore, the Agency has decided to propose alternative concentration-based treatment standards, based on the aforementioned data for all U and P wastewaters for which standards based on incinerator scrubber waters have been proposed. Further information on these alternative standards can be found in sections III.A.2.a.(3) and III.A.1.h.(b.) of the preamble for the proposed rule and in the document "Best Demonstrated Available Technology (BDAT) Background Document for Wastewaters Containing BDAT List Constituents" that can be found in the RCRA docket.

The Agency is also in the process of conducting wastewater treatment tests for selected U and P chemicals using wet air oxidation, powdered activated carbon treatment (PACT), and carbon adsorption treatment.

Since much of the currently available wastewater treatment data is from the treatment of relatively low concentrations of U and P constituents in industrial wastewaters, these tests have been designed to examine the applicability of treatment technologies to wastewaters containing relatively high concentrations of U and P constituents. The data developed in these studies will be placed in the administrative record for inspection and comment, when they become available. Further information on the availability of the forthcoming wastewater treatment test data can be found in section III.A.1.h.(6.) of the preamble for the proposed rule.

After review of all the available performance data for the aromatics and other hydrocarbons treatability group, the Agency decided to use the performance data from the incineration of K001 (creosote) to develop the proposed treatment standards for the aromatics and other hydrocarbon U-wastes. Because the aromatic U-waste constituents i.e., benzene, toluene and xylene(s) present in the K001 waste were treated to nondetectable levels, the Agency believes that based on waste characteristics affecting incineration treatment performance i.e., bond dissociation energy and boiling points, benzene (U019), toluene (U220), and xylenes (U239) will not be any more difficult to treat than benzene, toluene, and xylenes in K001 waste. EPA's rationale for transferring performance data for the aromatics from K001 treatment performance data is explained in detail in Section 6.1.

Tables 4-1 through 4-6 present the K001 (creosote) treatment performance data for the kiln ash and scrubber water residuals used to develop the proposed treatment standards for the aromatic U-wastes and other hydrocarbons. (The less than (<) sign indicates that the value is below the detection limit.) Tables 4-7 through 4-9 present the incinerator operating data for K001 wastes.

Table 4-1 Treatment Performance Data for Rotary Kiln Incineration of K001

K001 (Creosote)

Sample Set No. 1

BDAT list constituent	Untreated waste (mg/kg)	Treated nonwastewater (ash) (mg/kg)	Treated wastewater (scrubber water) (mg/l)
Volatile Organics			
Benzene	56	<10	<0.010
Toluene	110	<10	<0.010
Ethyl benzene	57	<10	<0.010
Xylenes	120	<10	<0.010
Semivolatile Organics			
Acenaphthene	21,000	<0.13	<0.004
Anthracene	15,000	<0.13	<0.002
Chrysene	4,800	<0.17	<0.003
Fluorene	18,000	<0.13	<0.002
Naphthalene	42,000	<0.11	<0.002
Phenanthrene	41,000	<0.36	<0.006
Phenol	2,400	<0.10	<0.002
Pyrene	17,000	<0.13	<0.002

Source: Radian Corp. 1987.

Table 4-2 Treatment Performance Data for Rotary Kiln Incineration of K001

K001 (Creosote)

Sample Set No. 2

BDAT list constituent	Untreated waste (mg/kg)	Treated nonwastewater (ash) (mg/kg)	Treated wastewater (scrubber water) (mg/l)
Volatile Organics			
Benzene	60	<10	<0.010
Toluene	120	<10	<0.010
Ethyl benzene	56	<10	<0.010
Xylenes	130	<10	<0.010
Semivolatile Organics			
Acenaphthalene	1,000	<0.13	<0.004
Acenaphthene	15,000	<0.13	<0.002
Anthracene	7,300	<0.13	<0.002
Chrysene	4,200	<0.17	<0.003
Fluorene	12,000	<0.13	<0.002
Naphthalene	40,000	<0.11	<0.002
Phenanthrene	32,000	<0.36	<0.006
Phenol	3700	<0.10	<0.002
Pyrene	13,000	<0.13	<0.002

Source: Radian Corp. 1987.

Table 4-3 Treatment Performance Data for Rotary Kiln Incineration of K001

K001 (Creosote)

Sample Set No. 3

BDAT list constituent	Untreated waste (mg/kg)	Treated nonwastewater (ash) (mg/kg)	Treated wastewater (scrubber water) (mg/l)
Volatile Organics			
Benzene	61	<10	<0.010
Toluene	100	<10	<0.010
Ethyl benzene	55	<10	<0.010
Xylenes	120	<10	<0.010
Semivolatile Organics			
Acenaphthene	19,000	<0.13	<0.004
Anthracene	12,000	<0.13	<0.002
Chrysene	4,800	<0.17	<0.003
Fluorene	16,000	<0.13	<0.002
Naphthalene	40,000	<0.11	<0.002
Phenanthrene	37,000	<1.36	<0.006
Phenol	3,600	<0.10	<0.002
Pyrene	16,000	<0.13	<0.002

Source: Radian Corp. 1987.

Table 4-4 Treatment Performance Data for Rotary Kiln Incineration of K001

K001 (Creosote)

Sample Set No. 4

BDAT list constituent	Untreated waste (mg/kg)	Treated nonwastewater (ash) (mg/kg)	Treated wastewater (scrubber water) (mg/l)
Volatile Organics			
Benzene	51	<0.10	<0.010
Toluene	110	<0.10	<0.010
Ethyl benzene	72	<0.10	<0.010
Xylenes	130	<0.10	<0.010
Semivolatile Organics			
Acenaphthene	16,000	<0.13	<0.004
Anthracene	8,500	<0.13	<0.002
Chrysene	4,100	<0.17	<0.003
Fluorene	14,000	<0.13	<0.002
Naphthalene	32,000	<0.11	<0.002
Phenanthrene	29,000	<0.36	<0.006
Phenol	3,900	<0.10	<0.002
Pyrene	12,000	<0.13	<0.002

Source: Radian Corp. 1987.

Table 4-6 Treatment Performance Data for Rotary Kiln Incineration of K001

K001 (Creosote)

Sample Set No. 5

BDAT list constituent	Untreated waste (mg/kg)	Treated nonwastewater (ash) (mg/kg)	Treated wastewater (scrubber water) (mg/l)
Volatile Organics			
Benzene	58	<0.10	<0.010
Toluene	110	<0.10	<0.010
Ethyl benzene	71	<0.10	<0.010
Xylenes	130	<0.10	<0.010
Semivolatile Organics			
Acenaphthene	19,000	<0.13	<0.004
Anthracene	7,400	<0.13	<0.002
Chrysene	4,200	<0.17	<0.003
Fluorene	16,000	<0.13	<0.002
Naphthalene	29,000	<0.11	<0.002
Phenanthrene	32,000	<0.36	<0.006
Phenol	2,400	<0.10	<0.002
Pyrene	15,000	<0.13	<0.002

Source: Radian Corp. 1987.

Table 4-6 Treatment Performance Data for Rotary Kiln Incineration of K001

K001 (Creosote)

Sample Set No. 6

BDAT list constituent	Untreated waste (mg/kg)	Treated nonwastewater (ash) (mg/kg)	Treated wastewater (scrubber water) (mg/l)
Volatile Organics			
Benzene	83	<0.10	<0.010
Toluene	170	<0.10	<0.010
Ethyl benzene	87	<0.10	<0.010
Xylenes	170	<0.10	<0.010
Semivolatile Organics			
Acenaphthene	17,000	<0.13	<0.004
Anthracene	9,100	<0.13	<0.002
Chrysene	4,300	<0.17	<0.003
Fluorene	14,000	<0.13	<0.002
Naphthalene	43,000	<0.11	<0.002
Phenanthrene	36,000	<0.36	<0.006
Phenol	3,300	<0.10	<0.002
Pyrene	13,000	<0.13	<0.002

Source: Radian Corp. 1987.

Table 4-7 Incinerator Operating Data for K001 (Creosote) Sample Sets Numbers 1 and 2

Parameter	Sample collected	K001-creosote feed rate (lb/h)	Temperature (°F)		Kiln rotation speed (rpm)	Stack gas concentrations		
			Kiln	Afterburner		O_2 (%)	CO (ppm)	CO_2 (%)
10/5/87								
Kiln shakedown (before K001-C feed)	Scrubber pretest water	0	1720-1917	1984-2019	0.25			
10/6/87								
Start feed 11:03		180			0.25			
Begin test 12:10	Feed[a]	180	1694-1873	1932-2016	0.25	4-9	12-27	8-12
12:30		180	1771-1886	2008-2031	0.25	4-12	22-32	3-11
13:00		180	1828-1863	2014-2031	0.25	4-20	18-33	5-12
13:30		180	1835-1874	2014-2035	0.25	5-8	30-34	1-11
13:40	Ash Recycle[b]	180	1835-1838	2030-2033	0.25	6-8	32-34	9-10
14:00	Feed[a]	180	1790-1860	1996-2033	0.25	5-9	32-37	8-11
14:30		180	1800-1913	1996-2034	0.25	5-8	32-37	9-11
15:00		180	1838-1906	2019-2035	0.25	6-8	34-37	8-11
15:25	Ash Recycle[b]	180	1795-1838	2006-2019	0.25	7-9	30-37	8-10

[a] The feed samples were collected while the fiber packs were being packed. Six drums were used for the 2 days of testing. K001 (creosote) waste from two drums was incinerated for each sample set.

[b] The scrubber recycle tank was not blown down during the test series. Makeup water was added to replace water lost through the exhaust system. No chemicals were added to the scrubber water system. The recycle water samples were taken from the scrubber recirculation line.

Source: USEPA 1987b.

Table 4-8 Incinerator Operating Data for K001 (Creosote) Sample Sets Numbers 3 and 4

Parameter	Sample collected	K001-creosote feed rate (lb/h)	Temperature, (°F)		Kiln rotation speed (rpm)	Stack gas concentrations		
			Kiln	Afterburner		O_2 (%)	CO (ppm)	CO_2 (%)
10/6/87								
Continued feed					0.25			
17:10	Feed[a]	180						
17:30		180	1775-1840	1985-2002	0.25	6-10	39-42	8-10
18:00		180	1827-1875	2002-2026	0.25	6-9	31-42	8-11
18:30		180	1827-1875	2007-2026	0.25	6-9	39-41	8-10
18:40	Ash	180	1822-1871	1993-2009	0.25	7-9	39-41	8-9
	Recycle[b]							
19:00	Feed[a]	180	1819-1826	1993-1997	0.25	7-9	37-41	8-10
19:30		180	1825-1878	1997-2008	0.25	7-9	31-42	8-11
20:00	Recycle[b]	180	1859-2028	1995-2093	0.25	4-9	39-720	8-13
20:15	Ash	180	1824-1859	1986-1995	0.25	7-10	35-38	8-10

[a] The feed samples were collected while the fiber packs were being packed. Six drums were used for the 2 days of testing. K001 (cresote) waste from two drums was incinerated for each sample set.

[b] The scrubber recycle tank was not blown down during the test series. Makeup water was added to replace water lost through the exhaust system. No chemicals were added to the scrubber water system. The recycle water samples were taken from the scrubber recirculation line.

Source: USEPA 1987b.

Table 4-9 Incinerator Operating Data for K001 - Creosote Sample Sets Numbers 5 and 6

Parameter	Sample collected	K001-creosote feed rate (lb/h)	Temperature, (°F) Kiln	Temperature, (°F) Afterburner	Kiln rotation speed, rpm	Stack gas concentrations O_2 (%)	Stack gas concentrations CO (ppm)	Stack gas concentrations CO_2 (%)
10/7/87								
Start feed 11:00		180			0.25			
Begin test 11:30	Feed[a]	180	1806-1841	2012-2020	0.25	4-8	15-18	9-12
12:00		180	1823-1912	2017-2039	0.25	2-9	15-30	9-13
12:30	Ash Recycle[b]	180	1830-1886	2019-2025	0.25	4-8	17-24	9-11
13:00	Feed[a]	180	1845-1910	2011-2025	0.25	5-9	19-25	9-10
13:30		180	1829-1845	1999-2011	0.25	6-9	18-22	9-10
14:00		180	1827-1838	1997-2009	0.25	7-9	18-22	9-10
14:30		180	1827-1857	1999-2022	0.25	7-9	15-23	9-10
14:45	Ash Recycle[b]	180	1844-1899	2022-2034	0.25	5-8	22-25	9-10
15:00		180	1896-1900	2026-2033	0.25	5-9	22-25	9-11

[a] The feed samples were collected while the fiber packs were being packed. Six drums were used for the 2 days of testing. K001 (creosote) waste from two drums was incinerated for each sample set.

[b] The scrubber recycle tank was not blown down during the test series. Makeup water was added to replace water lost through the exhaust system. No chemicals were added to the scrubber water system. The recycle water samples were taken from the scrubber recirculation line.

Source: USEPA 1987b.

5. IDENTIFICATION OF BEST DEMONSTRATED AVAILABLE TECHNOLOGY

This section contains the determination of the BDAT for the nonwastewater and wastewater forms of the aromatics and other hydrocarbon U-wastes.

The Agency believes that the aromatics and other hydrocarbon U-wastes listed in Tables 1-1 and 1-2 can be present in both nonwastewater and wastewater forms. Therefore, the Agency has developed treatment standards for both nonwastewaters and wastewaters. The nonwastewater streams may include the raw waste as generated, the ash residual after incineration, residuals from other types of demonstrated treatment technologies (identified in Section 3), and the residuals from treatment of incinerator scrubber wastewaters. The wastewater streams may include the raw waste as generated, or combustion gas scrubber water after incineration, or residuals from other demonstrated technologies (identified in Section 3) used to treat the waste.

5.1 Nonwastewaters

EPA has data from the incineration of F and K waste that contained constituents of concern from the aromatics and other hydrocarbons treatability group. These data from treatment of waste codes K001 creosote (used to develop the proposed treatment standards) show nondetectable levels for the constituents of concern in the treated residuals. Because the treated residuals are below the detection limits, the Agency does not expect that better treatment can be achieved for the constituents of concern.

Because data from the other demonstrated technologies identified in Section 3 are not available, the Agency cannot compare performance to

determine which technology is "best." however, since incineration treats to nondetectable levels, the Agency would not expect the level of performance to be improved by the other demonstrated technologies when compared to incineration.

EPA reviewed all the performance data available to determine whether substantial treatment was provided. The parameters examined included (1) the design and operating conditions, (2) the analytical testing, and (3) the quality assurance/quality control analyses of the data. After review of the above-mentioned parameters, EPA concluded that the data on which the Agency is basing treatment standards are of sufficient quality and show substantial treatment for the constituents of concern (because the constituents of concern in the residuals were treated below the detection limits). Design and operating conditions indicate that the treatment systems were all well designed and well operated during the test burns. In addition, the proper analytical tests and quality assurance techniques were performed on the untreated wastes and treated residuals. (For additional information on determination of BDAT, see EPA's Methodology for Developing Best Demonstrated Available Technology (BDAT) Treatment Standards.)

In addition, incineration is a commercially available technology. Since the criteria for best, demonstrated, and available have been met, the Agency has determined that incineration is BDAT for the nonwastewater forms of the aromatics and other hydrocarbon U-wastes.

5.2 Wastewaters

The Agency has data for scrubber water residuals from the incineration of F and K wastes that contained constituents of concern from the aromatics and other hydrocarbons treatability group. These data from treatment of waste codes K001 (creosote) (used to develop the wastewater treatment standards) show nondetectable levels for the

constituents of concern in the treated residuals. As a result, the Agency does not expect that better treatment can be achieved for the constituents of concern.

Because data from the other demonstrated technologies (identified in Section 3) are not presently available,* the Agency cannot compare performance to determine which technology is "best." The Agency, however, does not expect the level of performance to be improved by the other demonstrated technologies when compared to incineration scrubber waters since incineration treats to nondetectable levels. If EPA determines at a later date that other data are more appropriate, the Agency may include these data in the development of the final treatment standards.

EPA has determined that these incineration data (scrubber water data), as discussed in Section 5.1, are of sufficient quality and show substantial treatment (residuals were below the detection limit). Because incineration is a commercially available technology and the criteria for best, demonstrated, and available have been met, the Agency has determined that incineration is BDAT for wastewater forms of aromatics and other hydrocarbon U-wastes.

The Agency believes that incineration of these wastewaters is feasible because incineration typically provides significant destruction

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*The Agency is currently reviewing data from the Office of Water's data base, as well as data from wet air oxidation, powdered activated carbon, and carbon adsorption treatment, recently made available to the Agency, to determine whether these data are appropriate for developing the wastewater standards. If the Agency determines that these data are appropriate, EPA may include these data in the development of the final treatment standards. Although, these data were not available in time for incorporation into this background document, the Office of Water data may be found in the administrative record. The other above-mentioned data will be placed in the administrative record for inspection and comment, when the data becomes available.

(even for wastewaters) and that some of these wastewaters may actually contain high concentrations (near 1 percent total organic carbon (TOC) of carbon. Furthermore, commenters to the Second Third proposed rule, indicated that they indeed were incinerating many wastewaters and they did not want to be precluded from doing so where EPA had proposed only carbon adsorption as a method of treatment for wastewater forms of certain U and P organophosphorous pesticides.

EPA does not currently have a verified SW-846 analytical method for cumene (U055), cyclohexane (U056), or 1,3-pentadiene (U186) in treatment residues. As a result, the Agency is not proposing concentration-based treatment standards for these waste codes. The Agency is therefore proposing the following methods of treatment as BDAT for U055, U056 and U186 wastewaters: wet air oxidation or chemical oxidation followed by carbon adsorption; biodegradation followed by carbon adsorption; or incineration. Since these technologies are known to provide effective treatment for other organic constituents within each treatability group that can be analyzed, the Agency is therefore proposing these multiple treatment technologies as BDAT for U055, U056, and U186. None of the above-mentioned technologies have been specifically identified as better than the others due to the current lack of data for these constituents that are difficult to analyze, or for any other surrogate/indicator parameters. However, the Agency is currently investigating the potential use of surrogates/indicators that could be used to ensure complete destruction and to determine which technology performs best for these aromatics and other hydrocarbon U-wastes, i.e., U055, U056, and U186 in wastewaters.

6. CALCULATION OF PROPOSED BDAT TREATMENT STANDARDS

The Agency bases numerical treatment standards for regulated constituents on the performance of well-designed and well-operated BDAT treatment systems. These standards account for analytical limitations in available treatment performance data and for variabilities related to treatment, sampling, and analytical techniques and procedures. The purpose of this section is to calculate proposed treatment standards for the aromatics and other hydrocarbon U-wastes using the available treatment performance data from the BDAT treatment technologies.

The Agency has verified SW-846 analytical methods for benzene, toluene, and xylene(s); therefore, for these constituents, the Agency is proposing that concentration-based treatment standards be met before these wastes may be disposed of on land once the standards are finalized. However, the Agency does not have verified SW-846 (USEPA 1986d) analytical methods for cumene, cyclohexane, and 1,3-pentadiene; therefore, the Agency is proposing a method of treatment rather than concentration-based standards.

A discussion of how the treatment standards for these wastes were calculated is included in this section. For further information on calculation of BDAT treatment standards, refer to Methodology for Developing Best Demonstrated Available Treatment Technology (BDAT) Standards.

Treatment standards for the aromatics and other hydrocarbon U-wastes were calculated as follows. The Agency reviewed its BDAT incineration data base and identified waste codes that contained the major constituents of concern in the untreated and treated waste, and selected the K001 (creosote) performance data to be used for calculating the proposed nonwastewater and wastewater treatment standards for the aromatics and

other hydrocarbons treatability group. EPA decided to use the K001 (creosote) data because the K001 untreated waste contained all three of the constituents for which the Agency is proposing concentration-based standards -- benzene, toluene, and xylene(s). In addition, K001 (creosote) had the highest detection limits for the constituents of concern in the treated residuals among the waste codes considered for this rulemaking (see Appendix A). The Agency believed that this was an appropriate methodology for the U-wastes because of the uncertainity in the concentration of the U-wastes. Also, EPA chose to use the highest detection limits because lower detection limits may not be consistently achievable.

Treatment standards for nonwastewaters and wastewaters were calculated by multiplying the highest detection limit (i.e., from waste code K001, (creosote) as presented in Tables 6-1 and 6-2 at the end of this section) by the highest analytical recovery factor (i.e., lowest percent recovery) for the constituent and then by a variability factor of 2.8 (used when the treated residuals are below the detection unit). Appendix A presents the treated waste detection limits for all of the incineration performance data considered by the Agency for this rulemaking. This is discussed in more detail below.

Before the proposed treatment standards were calculated, the treatment performance data were corrected to account for analytical interferences associated with the chemical matrices of the samples. The treatment performance data were corrected by multiplying the detection limit data by the lowest percent recovery calculated for that constituent. The correction factor* was then calculated as the reciprocal of the lowest percent recovery. If recovery values were not available for a constituent, the Agency selected the lowest average

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* Recovery values above 100 percent were considered to be just 100 percent for the purpose of determining the analytical recovery factor.

percent recovery value for the base-neutral extractables. (Toluene, benzene, and xylene are base-neutral extractables as opposed to phenol-containing compounds, which are acid extractables.) (Percent recovery values for K001 (creosote) is presented in Appendix B of this document.)

The next step in calculating treatment standards was to determine the variability factor (VF) for each regulated constituent. The variability factor accounts for the variability inherent in treatment system performance, treatment residual collection, and analysis of the treated waste samples. K001 (creosote) treated residuals (constituents of concern) were treated below detection limits. Where concentrations in the treated waste were reported at less than or equal to the detection limit for all the points in the data set, variability is still expected since the actual concentration could range from 0 to the detection limit. In these cases, the Agency assumed a lognormal distribution of data points between the detection limit and a value 1/10th of the detection limit and calculated a variability of 2.8. (For more information on calculation of variability factors, see EPA's Methodology for Developing BDAT Treatment Standards.

Hence, the proposed treatment standards were calculated by multiplying the average of the analytically corrected treatment performance values by the variability factor of 2.8 for each constituent.

Tables 6-1 and 6-2 summarize the calculation of treatment standards for U019, U220, and U239. Section 6.1.1 describes the calculation of the proposed treatment standards in more detail. Section 6.1.2 discusses the Agency's decision to propose a method of treatment as BDAT for U055, U056, and U186. Section 6.2 discussess the calculation of the proposed BDAT for the wastewater forms of U055, U056, and U186.

6.1 Nonwastewaters

6.1.1 Calculation of Proposed Treatment Standards for Nonwastewater Forms of U019, U220, and U239

The proposed treatment standards for nonwastewater forms of benzene (U019), toluene (U220), and xylenes (U239) were calculated using the incineration performance/data detection limits from K001 (creosote) for benzene, toluene and xylenes. Table 6-3 presents the treated ash concentration values (detection limits) of K001 (creosote) waste. Appendix A presents the detection limit data for all of the incineration data considered for this rulemaking (i.e., all waste codes treatment data in addition to K001).

All of the above-mentioned constituents were present in the untreated K001 waste (creosote); therefore, the proposed treatment standards were calculated by multiplying the detection limit of the constituent times the analytical correction factor times a variability factor of 2.8.

6.1.2 Wastes for Which EPA is Proposing a Method of Treatment as BDAT

Based on structural similarities, the Agency believes that incineration also represents BDAT for cumene (U055), cyclohexane (U056), and 1,3-pentadiene (U186) wastes. However, the Agency does not believe that concentration-based standards for these waste codes are feasible at this time. The major problem in establshing concentration-based standards for these waste codes is that EPA does not currently have a verified SW-846 analytical method that can analyze for the concentrations of cumene (U055), cyclohexane (U056), or 1,3-pentadiene (U186) in treatment residues. Instead, the Agency is proposing a treatment standard of "incineration as a method of treatment" for U055, U056, and U186 nonwastewaters.

6.2 Wastewaters

6.2.1 Calculation of Proposed Treatment Standards for Wastewaters Forms of U019, U220, and U239

The proposed BDAT treatment standards for benzene (U019), toluene (U220), and xylenes (U239) are based on the K001 (creosote) incineration scrubber water residuals. The methodology for the transfer of performance data and establishment of proposed methods of treatment for these aromatic U-Wastes is identical to that presented in sections 6.1.1 and 6.1.2 for nonwastewater forms; however, the concentration-based standards for wastewaters are based on incinerator scrubber water residuals. (Detection limits for the K001 creosote scrubber water residuals are presented in Table 6-4.)

EPA is proposing to use the incineration scrubber water residuals to develop the proposed wastewater standards because incineration typically provides significant destruction (even for wastewaters) and that some of the wastewaters may actually contain high concentrations (near 1 percent total organic carbon (TOC)) of carbon. Furthermore, commenters to the Second Third proposed rule, indicated that they indeed were incinerating many wastewaters and they did not want to be precluded from doing so where EPA had proposed only carbon adsorption as a method of treatment for wastewater forms of certain U and P organophosphorous pesticides. However, additional data are available for the treatment of these constituents in wastewaters and alternative standards based on these data are presented in Section III.A.7 of the preamble notice of wastewater forms of multisource leachate.

6.2.2 Wastes for Which EPA is Proposing a Method of Treatment as BDAT

The Agency has determined that there is no current verified SW-846 method that can analyze for the concentrations of cumene (U055),

cyclohexane (U056), or 1,3-pentadiene (U186) in treatment residues. As a result, concentration-based standards for these constituents are not feasible. See Section A.1.h.(2.)(b.) of the preamble for further discussion of the Agency's approach in such instances. Since Section 3004(m) of RCRA allows the Agency to establish either levels or methods of treatment, the Agency is proposing a standard of wet air oxidation or chemical oxidation followed by carbon adsorption, biodegradation followed by carbon adsorption, or incineration as a method of treatment for U055, U056, and U186 wastewaters.

Table 6-1 Calculation of Proposed Treatment Standards for Aromatic U-Wastes (Nonwastewaters)

Waste code	Constituent	Waste detection limit transferred from	Highest detection limit (ppm) (DL)	Accuracy correction factor (ACF)	Constituent correction factor transferred from	Variability factor (VF)	Treatment standard (ppm) (DL x ACF x VF)
U019	Benzene	K001 (creosote)	10	1.28	K001 (creosote)	2.8	36
U220	Toluene	K001 (creosote)	10	1.01	K001 (creosote)	2.8	28
U239	Xylene (total)	K001 (creosote)	10	1.16	K001 (creosote)	2.8	33

Table 6-2 Calculation of Proposed Treatment Standards for Aromatic U-Wastes (Wastewaters)

Waste code	Constituent	Waste detection limit transferred from	Highest detection limit (ppm) (DL)	Accuracy correction factor (ACF)	Constituent correction factor transferred from	Variability factor (VF)	Treatment standard (ppm) (DL x ACF x VF)
U019	Benzene	K001 (creosote)	0.010	1.18	K001 (creosote)	2.8	0.033
U220	Toluene	K001 (creosote)	0.010	1.01	K001 (creosote)	2.8	0.028
U239	Xylene (total)	K001 (creosote)	0.010	1.15	K001 (creosote)	2.8	0.032

Table 6-3 K001 Creosote Ash Detection Limits

Constituent/parameter	Detection limit Sample set # 1	2	3	4	5	6	7
BDAT Volatile Organics (ppm)							
Acetonitrile	200	200	200	200	200	200	200
Acrolein	500	500	500	500	500	500	500
Acrylonitrile	10	10	10	10	10	10	10
Benzene	10	10	10	10	10	10	10
Bromodichloromethane	10	10	10	10	10	10	10
Bromomethane	10	10	10	10	10	10	10
Carbon disulfide	10	10	10	10	10	10	10
Carbon tetrachloride	10	10	10	10	10	10	10
Chlorobenzene	10	10	10	10	10	10	10
Chlorodibromomethane	10	10	10	10	10	10	10
Chloroethane	10	10	10	10	10	10	10
Chloroform	10	10	10	10	10	10	10
Chloromethane	10	10	10	10	10	10	10
2-Chloro-1,3-butadiene	NA	NA	NA	NA	NA	NA	NA
2-Chloroethyl vinyl ether	100	100	100	100	100	100	100
3-Chloropropene	10	10	10	10	10	10	10
1,2-Dibromo-3-chloropropene	10	10	10	10	10	10	10
1,2-Dibromomethane	10	10	10	10	10	10	10
Dibromomethane	10	10	10	10	10	10	10
Dichlorodifluoromethane	10	10	10	10	10	10	10
1,1-Dichloroethane	10	10	10	10	10	10	10
1,2-Dichloroethane	10	10	10	10	10	10	10
1,1-Dichloroethylene	10	10	10	10	10	10	10
trans-1,2-Dichloroethane	10	10	10	10	10	10	10
trans-1,4-Dichloro-2-butene	10	10	10	10	10	10	10
1,2-Dichloropropane	10	10	10	10	10	10	10
trans-1,3-Dichloropropene	10	10	10	10	10	10	10
cis-1,3-Dichloropropene	10	10	10	10	10	10	10
1,4-Dioxane	NA	NA	NA	NA	NA	NA	NA
Ethyl cyanide	NA	NA	NA	NA	NA	NA	NA
Ethyl methacrylate	50	50	50	50	50	50	50
Iodomethane	20	20	20	20	20	20	20
Isobutyl alcohol	NA	NA	NA	NA	NA	NA	NA
Methyl ethyl ketone	50	50	50	50	50	50	50
Methyl methacrylate	50	50	50	50	50	50	50

Source: Radian Corp. 1987

Table 6-3 (continued)

Constituent/parameter	Detection limit Sample set # 1	2	3	4	5	6	7
BOAT Volatile Organics (ppm) (continued)							
Methyl methanesulfonate	NA	NA	NA	NA	NA	NA	NA
Methylacrylonitrile	NA	NA	NA	NA	NA	NA	NA
Methylene chloride	50	50	50	50	50	50	50
1,1,1,2-Tetrachloroethane	10	10	10	10	10	10	10
1,1,2,2-Tetrachloroethane	10	10	10	10	10	10	10
Tetrachloroethene	10	10	10	10	10	10	10
Toluene	10	10	10	10	10	10	10
Tribromomethane	10	10	10	10	10	10	10
1,1,1-Trichloroethane	10	10	10	10	10	10	10
1,1,2-Trichloroethane	10	10	10	10	10	10	10
Trichloroethene	10	10	10	10	10	10	10
Trichlorofluoromethane	10	10	10	10	10	10	10
1,2,3-Trichloropropane	10	10	10	10	10	10	10
Vinyl chloride	10	10	10	10	10	10	10
Ethylbenzene	10	10	10	10	10	10	10
Xylenes	10	10	10	10	10	10	10
Styrene	10	10	10	10	10	10	10
Ethyl ether	NA	NA	NA	NA	NA	NA	NA
Ethyl acetate	10	10	10	10	10	10	10
Epichlorohydrin	NA	NA	NA	NA	NA	NA	NA
Acetone	50	50	50	50	50	50	50
Methyl isobutyl ketone	100	100	100	100	100	100	100
Di-n-propylnitrosoamine	NA	NA	NA	NA	NA	NA	NA
Chlorodifluoromethane	NA	NA	NA	NA	NA	NA	NA
1,3-Butadiene	NA	NA	NA	NA	NA	NA	NA
Hexachloropentadiene	NA	NA	NA	NA	NA	NA	NA
Cumene	NA	NA	NA	NA	NA	NA	NA
Benzyl chloride	NA	NA	NA	NA	NA	NA	NA
Acetaldehyde	NA	NA	NA	NA	NA	NA	NA
Cyclohexanone	NA	NA	NA	NA	NA	NA	NA
Dimethyl nitrosoamine	NA	NA	NA	NA	NA	NA	NA
Methyl acetate	NA	NA	NA	NA	NA	NA	NA
Propylene oxide	NA	NA	NA	NA	NA	NA	NA
Phthalic anhydride	NA	NA	NA	NA	NA	NA	NA

Source: Radian Corp. 1987

Table 6-4 K001 Creosote Scrubber Water Detection Limits

Constituent/parameter	Detection limit Sample set # 1	2	3	4	5	6	7
BDAT Volatile Organics (ppb)							
Acetonitrile	200	200	200	200	200	200	200
Acrolein	500	500	500	500	500	500	500
Acrylonitrile	10	10	10	10	10	10	10
Benzene	10	10	10	10	10	10	10
Bromodichloromethane	10	10	10	10	10	10	10
Bromomethane	10	10	10	10	10	10	10
Carbon disulfide	10	10	10	10	10	10	10
Carbon tetrachloride	10	10	10	10	10	10	10
Chlorobenzene	10	10	10	10	10	10	10
Chlorodibromomethane	10	10	10	10	10	10	10
Chloroethane	10	10	10	10	10	10	10
Chloroform	10	10	10	10	10	10	10
Chloromethane	10	10	10	10	10	10	10
2-Chloro-1,3-butadiene	NA	NA	NA	NA	NA	NA	NA
2-Chloroethyl vinyl ether	100	100	100	100	100	100	100
3-Chloropropene	10	10	10	10	10	10	10
1,2-Dibromo-3-chloropropene	10	10	10	10	10	10	10
1,2-Dibromomethane	10	10	10	10	10	10	10
Dibromomethane	10	10	10	10	10	10	10
Dichlorodifluoromethane	10	10	10	10	10	10	10
1,1-Dichloroethane	10	10	10	10	10	10	10
1,2-Dichloroethane	10	10	10	10	10	10	10
1,1-Dichloroethylene	10	10	10	10	10	10	10
trans-1,2-Dichloroethane	10	10	10	10	10	10	10
trans-1,4-Dichloro-2-butene	10	10	10	10	10	10	10
1,2-Dichloropropane	10	10	10	10	10	10	10
trans-1,3-Dichloropropene	10	10	10	10	10	10	10
cis-1,3-Dichloropropene	10	10	10	10	10	10	10
1,4-Dioxane	NA	NA	NA	NA	NA	NA	NA
Ethyl cyanide	NA	NA	NA	NA	NA	NA	NA
Ethyl methacrylate	50	50	50	50	50	50	50
Iodomethane	20	20	20	20	20	20	20
Isobutyl alcohol	NA	NA	NA	NA	NA	NA	NA
Methyl ethyl ketone	50	50	50	50	50	50	50
Methyl methacrylate	50	50	50	50	50	50	50

Source: Radian Corp. 1987

Table 6-4 (continued)

Constituent/parameter	Detection limit Sample set # 1	2	3	4	5	6	7
BDAT Volatile Organics (ppb) (continued)							
Methyl methanesulfonate	NA	NA	NA	NA	NA	NA	NA
Methylacrylonitrile	NA	NA	NA	NA	NA	NA	NA
Methylene chloride	50	50	50	50	50	50	50
1,1,1,2-Tetrachloroethane	10	10	10	10	10	10	10
1,1,2,2-Tetrachloroethane	10	10	10	10	10	10	10
Tetrachloroethene	10	10	10	10	10	10	10
Toluene	10	10	10	10	10	10	10
Tribromomethane	10	10	10	10	10	10	10
1,1,1-Trichloroethane	10	10	10	10	10	10	10
1,1,2-Trichloroethane	10	10	10	10	10	10	10
Trichloroethene	10	10	10	10	10	10	10
Trichlorofluoromethane	10	10	10	10	10	10	10
1,2,3-Trichloropropane	10	10	10	10	10	10	10
Vinyl chloride	10	10	10	10	10	10	10
Ethylbenzene	10	10	10	10	10	10	10
Xylenes	10	10	10	10	10	10	10
Styrene	10	10	10	10	10	10	10
Ethyl ether	NA	NA	NA	NA	NA	NA	NA
Ethyl acetate	10	10	10	10	10	10	10
Epichlorohydrin	NA	NA	NA	NA	NA	NA	NA
Acetone	50	50	50	50	50	50	50
Methyl isobutyl ketone	100	100	100	100	100	100	100
Di-n-propylnitrosoamine	NA	NA	NA	NA	NA	NA	NA
Chlorodifluoromethane	NA	NA	NA	NA	NA	NA	NA
1,3-Butadiene	NA	NA	NA	NA	NA	NA	NA
Hexachloropentadiene	NA	NA	NA	NA	NA	NA	NA
Cumene	NA	NA	NA	NA	NA	NA	NA
Benzyl chloride	NA	NA	NA	NA	NA	NA	NA
Acetaldehyde	NA	NA	NA	NA	NA	NA	NA
Cyclohexanone	NA	NA	NA	NA	NA	NA	NA
Dimethyl nitrosoamine	NA	NA	NA	NA	NA	NA	NA
Methyl acetate	NA	NA	NA	NA	NA	NA	NA
Propylene oxide	NA	NA	NA	NA	NA	NA	NA
Phthalic anhydride	NA	NA	NA	NA	NA	NA	NA

Source: Radian Corp. 1987

7. REFERENCES

APHA, AWWA, and WPCF. 1985. American Public Health Association, American Water Works Association, and Water Pollution Control Federation. Standard methods for the examination of water and wastewater. 16th ed. Washington, D.C.: American Public Health Association.

Aldrich Chemical Company. 1988. Catalogue handbook of fine chemicals.

Dean, J.A., ed. 1979. Lange's handbook of chemistry. 12th ed. McGraw-Hill.

Environ Corp. Characterization of waste streams listed in the 40 CFR Section 261 waste profiles. Prepared for U.S. EPA, Waste Identification Branch, Characterization and Assessment Divison.

Kirk, R.E., and Othmer, D.F., eds. 1979. Encyclopedia of chemical technology, 3rd ed. New York: John Wiley and Sons.

National Library of Medicine. 1989. Hazardous substances data bank.

Radian Corp. 1987. Analytical results, Combustion Research Facility test burn, K001 creosote waste. Austin, Texas: Radian Corporation.

Sanderson, R.T. 1971. Chemical bonds and bond energy. New York and London: Academic Press.

SRI International. 1988. 1988 Directory of chemical producers--United States of America. Menlo Park, California: SRI International.

USEPA. 1985. U.S. Environmental Protection Agency. Physical-chemical properties and categorization of RCRA wastes according to volatility. EPA-450/3-85-007. Washington, D.C.: U.S. Environmental Protection Agency.

USEPA. 1986. U.S. Environmental Protection Agency, Office of Solid Waste. National survey of hazardous waste treatment, storage, disposal, and recycling facilities. Washington, D.C.: U.S. Environmental Protection Agency.

USEPA. 1987a. U.S. Environmental Protection Agency, Office of Solid Waste. Onsite engineering report of treatment technology. Performance and operation for incineration of K024 waste at the U.S. Environmental Protection Agency Combustion Research Facility. Washington, D.C.: U.S. Environmental Protection Agency.

USEPA. 1987b. U.S. Environmental Protection Agency, Office of Solid Waste. Onsite engineering report of treatment performance and operation for incineration of K001 - pentachlorophenol (PCP) and creosote at the U.S. Environmental Protection Agency Combustion Research Facility. Washington, D.C.: U.S. Environmental Protection Agency.

USEPA. 1987c. U.S. Environmental Protection Agency, Office of Solid Waste. Onsite engineering report of treatment for incineration of K015 waste at the John Zink Co. test facility. Washington, D.C.: U.S. Environmental Protection Agency.

USEPA. 1987d. U.S. Environmental Protection Agency, Office of Solid Waste. Onsite engineering report of stabilization of fluidized bed incineration ash at U.S. Army Corps of Engineers Waterways Experiment Station, Vicksburg, Mississippi, for K048/K051. Washington, D.C.: U.S. Environmental Protection Agency.

USEPA. 1987e. U.S. Environmental Protection Agency, Office of Solid Waste. Generic Quality Assurance Project Plan for Land Disposal Restrictions Program ("BDAT"). Washington, D.C.: U.S. Environmental Protection Agency.

USEPA. 1988a. U.S. Environmental Protection Agency, Office of Solid Waste. Best demonstrated available technology (BDAT) background document for K024 waste. Washington, D.C: U.S. Environmental Protection Agency.

USEPA. 1988b. U.S. Environmental Protection Agency, Office of Solid Waste. Best demonstrated available technology (BDAT) background document for K037 waste. Washington, D.C: U.S. Environmental Protection Agency.

USEPA. 1988c. U.S. Environmental Protection Agency, Office of Solid Waste. Best demonstrated available technology (BDAT) background document for K086 waste. Washington, D.C.: U.S. Environmental Protection Agency.

USEPA. 1988d. U.S. Environmental Protection Agency, Office of Solid Waste. Best demonstrated available technology (BDAT) background document for K101 waste. Washington, D.C.: U.S. Environmental Protection Agency.

USEPA. 1988e. U.S. Environmental Protection Agency, Office of Solid Waste. Best demonstrated available technology (BDAT) background document for K102 waste. Washington, D.C.: U.S. Environmental Protection Agency.

USEPA. 1988f. U.S. Environmental Protection Agency, Office of Solid Waste. Best demonstrated available technology (BDAT) background document for K001 waste. Washington, D.C.: U.S. Environmental Protection Agency.

USEPA. 1988g. U.S. Environmental Protection Agency, Office of Solid Waste. Best demonstrated available technology (BDAT) background document for K015 waste. Washington, D.C.: U.S. Environmental Protection Agency.

USEPA. 1988h. U.S. Environmental Protection Agency, Office of Solid Waste. Best demonstrated available technology (BDAT) background document for K019 waste. Washington, D.C.: U.S. Environmental Protection Agency.

USEPA. 1988i. U.S. Environmental Protection Agency, Office of Solid Waste. Best demonstrated available technology (BDAT) background document for K022 waste. Washington, D.C.: U.S. Environmental Protection Agency.

USEPA. 1988j. U.S. Environmental Protection Agency, Office of Solid Waste. Best demonstrated available technology (BDAT) background document for K048/K051 waste. Washington, D.C.: U.S. Environmental Protection Agency.

USEPA. 1988k. U.S. Environmental Protection Agency, Office of Solid Waste. Best demonstrated available technology (BDAT) background document for K087 waste. Washington, D.C.: U.S. Environmental Protection Agency.

USEPA. 1988l. U.S. Environmental Protection Agency, Office of Solid Waste. Draft onsite engineering report of treatment technology performance and operation for K087 waste at the Combustion Research Facility, Jefferson, Arkansas. Washington, D.C.: U.S. Environmental Protection Agency.

USEPA. 1988m. U.S. Environmental Protection Agency, Office of Solid Waste. Final onsite engineering report of treatment technology performance and operation for Rollins Environmental Services (TX) Inc. Deer Park, Texas. Washington, D.C.: U.S. Environmental Protection Agency.

USEPA. 1988n. U.S. Environmental Protection Agency, Office of Solid Waste. Onsite engineering report John Zink Company, Tulsa, Oklahoma, for K101. Washington, D.C.: U.S. Environmental Protection Agency.

USEPA. 1988o. U.S. Environmental Protection Agency, Office of Solid Waste. Onsite engineering report John Zink Company, Tulsa, Oklahoma for K102. Washington, D.C.: U.S. Environmental Protection Agency.

USEPA. 1988p. U.S. Environmental Protection Agency, Office of Solid Waste. Onsite engineering report for K011/K013/K014 wastes. Washington, D.C.: U.S. Environmental Protection Agency.

USEPA. 1988q. U.S. Environmental Protection Agency, Office of Solid Waste. Treatment technology background document. Washington, D.C.: U.S. Environmental Protection Agency.

USEPA. 1988r. U.S. Environmental Protection Agency, Office of Solid Waste. Best demonstrated available technology (BDAT) background document for F006 waste. Washington, D.C.: U.S. Environmental Protection Agency.

USEPA. 1988s. U.S. Environmental Protection Agency, Office of Solid Waste. Best demonstrated available technology (BDAT) background document for K061 waste. Washington, D.C.: U.S. Environmental Protection Agency.

USEPA. 1988t. U.S. Environmental Protection Agency, Office of Solid Waste. Draft onsite engineering report of treatment technology performance and operation for incineration of K037 waste at the U.S. Environmental Protection Agency Combustion Research Facility. Washington, D.C.: U.S. Environmental Protection Agency.

USEPA. 1989a. U.S. Environmental Protection Agency, Office of Solid Waste. Best demonstrated available technology (BDAT) background document for F024 waste. Washington, D.C.: U.S. Environmental Protection Agency.

USEPA. 1989b. U.S. Environmental Protection Agency, Office of Solid Waste. Onsite engineering report of treatment technology performance and operation for John Zink Company. Washington, D.C.: U.S. Environmental Protection Agency.

USEPA. 1989c. U.S. Environmental Protection Agency, Office of Solid Waste. Methodology for developing best demonstrated available technology (BDAT) treatment standards. Washington, D.C.: U.S. Environmental Protection Agency.

USEPA. 1989d. U.S. Environmental Protection Agency, Water Engineering Research Laboratory (WERL) Treatability Data Base. Cincinnati, Ohio.

Weast, R.C., ed. 1980. CRC handbook of chemistry and physics. 61st ed. Boca Raton, Florida: CRC Press, Inc.

Windholz, M., ed. 1983. The Merck index. 10th ed. Rathway, New Jersey: Merck & Company.

Appendix A

EPA-Collected Detection Limit Data for Nonwastewater and Wastewater Forms of F and K waste with Aromatics and Other Hydrocarbon U-Wastes Constituents Treated by Incineration (ppm)

Appendix A EPA-Collected Data for Nonwastewater Forms of F and K Waste, Aromatic Constituents Treated by Incineration

Waste code	Constituent	Concentration of constituent in untreated K and F waste (ppm)	Detection limits (ppm) F024 Sample 1	Sample 2	Sample 3	Sample 4	Sample 5	Sample 6
U019	Benzene	NP	0.005	0.005	0.005	0.005	0.005	0.005
U220	Toluene	NP	0.005	0.005	0.005	0.005	0.005	0.005
U230	Xylene (total)	NP	0.005	0.005	0.005	0.005	0.005	0.005

Waste code	Constituent	Concentration of constituent in untreated K and F waste (ppm)	Detection limits (ppm) K001 (PCP) Sample 1	Sample 2	Sample 3
U019	Benzene	8.5	2.0	2.0	2.0
U220	Toluene	10-41	2.0	2.0	2.0
U230	Xylene (total)	12-130	2.0	2.0	2.0

Waste code	Constituent	Concentration of constituent in untreated K and F waste (ppm)	Detection limits (ppm) K001 (Creosote) Sample 1	Sample 2	Sample 3	Sample 4	Sample 5	Sample 6
U019	Benzene	51-83	10.0	10.0	10.0	10.0	10.0	10.0
U220	Toluene	100-170	10.0	10.0	10.0	10.0	10.0	10.0
U230	Xylene (total)	120-170	10.0	10.0	10.0	10.0	10.0	10.0

NP - Not present above the detection limit.

Source: USEPA 1987b.
USEPA 1988f
USEPA 1989a

Appendix A (continued)

Waste code	Constituent	Concentration of constituent in untreated K and F waste (ppm)	Detection limits (ppm) K011/K013/K014 Sample 1	Sample 2	Sample 3	Sample 4	Sample 5	Sample 6	Sample 7
U019	Benzene	48-61	2.0	2.0	2.0	2.0	2.0	2.0	2.0
U220	Toluene	NP	2.0	2.0	2.0	2.0	2.0	2.0	2.0
U230	Xylene (total)	NP	2.0	2.0	2.0	2.0	2.0	2.0	2.0

Waste code	Constituent	Concentration of constituent in untreated K and F waste (ppm)	Detection limits (ppm) K015 Sample 1	Sample 2	Sample 3	Sample 4	Sample 5	Sample 6
U019	Benzene	NP						
U220	Toluene	NP			NO ASH DATA			
U230	Xylene (total)	NP						

Waste code	Constituent	Concentration of constituent in untreated K and F waste (ppm)	Detection limits (ppm) K019 Sample 1	Sample 2	Sample 3	Sample 4	Sample 5	Sample 6
U019	Benzene	NP	2.0	2.0	2.0	2.0	2.0	2.0
U220	Toluene	NP	2.0	2.0	2.0	2.0	2.0	2.0
U230	Xylene (total)	NP	2.0	2.0	2.0	2.0	2.0	2.0

NP - Not present above the detection limit.
Sources: USEPA 1987c, USEPA 1988g, USEPA 1988h, USEPA 1988p.

Appendix A (continued)

Waste code	Constituent	Concentration of constituent in untreated K and F waste (ppm)	Detection limits (ppm) K022 (Plant 1) Sample 1	Sample 2	Sample 3	Sample 4	Sample 5	Sample 6
U019	Benzene	CBI Information	0.014	0.014	0.014	0.014	0.014	0.014
U220	Toluene	CBI Information	0.012	0.012	0.012	0.012	0.012	0.012
U230	Xylene (total)	CBI Information	ND	ND	ND	ND	ND	ND

Waste code	Constituent	Concentration of constituent in untreated K and F waste (ppm)	Detection limits (ppm) K022 (Plant 2) Sample 1	Sample 2	Sample 3	Sample 4	Sample 5	Sample 6
U019	Benzene	CBI Information	0.014	0.014	0.014	0.014	0.014	0.014
U220	Toluene	CBI Information	0.012	0.012	0.012	0.012	0.012	0.012
U230	Xylene (total)	CBI Information	ND	ND	ND	ND	ND	ND

Waste code	Constituent	Concentration of constituent in untreated K and F waste (ppm)	Detection limits (ppm) K024 Sample 1	Sample 2	Sample 3
U019	Benzene	NP	2.0	2.0	2.0
U220	Toluene	NP	2.0	2.0	2.0
U230	Xylene (total)	NP	2.0	2.0	2.0

ND - No data available.
CBI - Confidential Business Information.
NP - Not present above the detection limit.
Sources: USEPA 1988a, USEPA 1988i.

Appendix A (continued)

Waste code	Constituent	Concentration of constituent in untreated K and F waste (ppm)	Detection limits (ppm) K037 Sample 1	Sample 2	Sample 3	Sample 4	Sample 5	Sample 6	Sample 7
U019	Benzene	NP	2.0	2.0	2.0	2.0	2.0	2.0	2.0
U220	Toluene	201-2,000	2.0	2.0	2.0	2.0	2.0	2.0	2.0
U230	Xylene (total)	NP	2.0	2.0	2.0	2.0	2.0	2.0	2.0

Waste code	Constituent	Concentration of constituent in untreated K and F waste (ppm)	Detection limits (ppm) K048/K051 Sample 1	Sample 2	Sample 3	Sample 4	Sample 5	Sample 6
U019	Benzene	NP	2.0	2.0	2.0	2.0	2.0	2.0
U220	Toluene	22-120	2.0	2.0	2.0	2.0	2.0	2.0
U230	Xylene (total)	<14-120	2.0	2.0	2.0	2.0	2.0	2.0

Waste code	Constituent	Concentration of constituent in untreated K and F waste (ppm)	Detection limits (ppm) K086 Sample 1	Sample 2	Sample 3	Sample 4	Sample 5	Sample 6
U019	Benzene	[CBI]	NO ASH DATA					
U220	Toluene	[CBI]						
U230	Xylene (total)	[CBI]						

Waste code	Constituent	Concentration of constituent in untreated K and F waste (ppm)	Detection limits (ppm) K087 Sample 1	Sample 2	Sample 3	Sample 4	Sample 5
U019	Benzene	5.6-212	0.025	0.025	0.025	0.025	0.025
U220	Toluene	5.0-152	0.025	0.025	0.025	0.025	0.025
U230	Xylene (total)	3.0-123	0.025	0.025	0.025	0.025	0.025

NP - Not present above the detection limit.
Sources: USEPA 1986b, USEPA 1987d, USEPA 1987e, USEPA 1988b, USEPA 1988c, USEPA 1988j, USEPA 1988t.

Appendix A (continued)

Waste code	Constituent	Concentration of constituent in untreated K and F waste (ppm)	Detection limits (ppm) K101 Sample 1	Sample 2	Sample 3
U019	Benzene	NP	0.005	0.005	0.005
U220	Toluene	<25-42	0.005	0.005	0.005
U230	Xylene (total)	NP	0.005	0.005	0.005

Waste code	Constituent	Concentration of constituent in untreated K and F waste (ppm)	Detection limits (ppm) K102 Sample 1	Sample 2	Sample 3	Sample 4	Sample 5
U019	Benzene	NP	1.5	1.5	1.5	1.5	1.5
U220	Toluene	NP	1.5	1.5	1.5	1.5	1.5
U230	Xylene (total)	<1.5-5.3	1.5	1.5	1.5	1.5	1.5

Waste code	Constituent	Concentration of constituent in untreated K and F waste (ppm) Test 1	Test 2	Detection limits (ppm) June 1989 John Zink Pesticides Test Burn Test 2 Sample 1	Sample 2	Sample 3	Sample 4	Test 2 Sample 1	Sample 2	Sample 3	Sample 4
U019	Benzene	NP	NP	0.010	0.010	0.010	0.010	0.005	0.010	0.005	0.005
U220	Toluene	69,000	<0.010-<6300	0.010	0.010	0.010	0.010	0.005	0.010	0.005	0.005
U230	Xylene (total)	NP	NP	0.010	0.010	0.010	0.010	0.005	0.010	0.005	0.005

NP - Not present above the detection limit.
Sources: USEPA 1988d, USEPA 1988e, USEPA 1988n, USEPA 1988o, USEPA 1989b.

Appendix A EPA-Collected Data for Wastewater forms of K and F Waste, Aromatic Constituents treated by Incineration

Waste code	Constituent	Concentration of constituent in untreated K and F waste (ppm)	Detection limits (ppm) F024 Sample 1	Sample 2	Sample 3	Sample 4	Sample 5	Sample 6
U019	Benzene	NP	0.005	0.005	0.005	0.005	0.005	0.005
U220	Toluene	NP	0.005	0.005	0.005	0.005	0.005	0.005
U230	Xylene (total)	NP	0.005	0.005	0.005	0.005	0.005	0.005

Waste code	Constituent	Concentration of constituent in untreated K and F waste (ppm)	Detection limits (ppm) K001 (PCP) Sample 1	Sample 2	Sample 3
U019	Benzene	NP	0.002	0.002	0.002
U220	Toluene	NP	0.002	0.002	0.002
U230	Xylene (total)	10-39	0.002	0.002	0.002

Waste code	Constituent	Concentration of constituent in untreated K and F waste (ppm)	Detection limits (ppm) K001 Creosote Sample 1	Sample 2	Sample 3	Sample 4	Sample 5	Sample 6	Sample 7
U019	Benzene	51-83	0.010	0.010	0.010	0.010	0.010	0.010	0.010
U220	Toluene	100-170	0.010	0.010	0.010	0.010	0.010	0.010	0.010
U230	Xylene (total)	120-170	0.010	0.010	0.010	0.010	0.010	0.010	0.010

NP - Not present above the detection limit.
Sources: USEPA 1987b, USEPA 1988f, USEPA 1989a.

Appendix A (continued)

Waste code	Constituent	Concentration of constituent in untreated K and F waste (ppm)	Detection limits (ppm) K001/K013/K014 Sample 1	Sample 2
U019	Benzene	48-61	0.0008	0.0008
U220	Toluene	NP	0.0012	0.0012
U230	Xylene (total)	NP	0.0009	0.0009

Waste code	Constituent	Concentration of constituent in untreated K and F waste (ppm)	Detection limits (ppm) K015 Sample 1	Sample 2	Sample 3	Sample 4
U019	Benzene	NP	0.002	0.002	0.002	0.002
U220	Toluene	NP	0.002	0.002	0.002	0.002
U230	Xylene (total)	NP	0.002	0.002	0.002	0.002

Waste code	Constituent	Concentration of constituent in untreated K and F waste (ppm)	Detection limits (ppm) K019 Sample 1	Sample 2	Sample 3	Sample 4	Sample 5	Sample 6
U019	Benzene	NP	0.002	0.002	0.002	0.002	0.002	0.002
U220	Toluene	NP	0.002	0.002	0.002	0.002	0.002	0.002
U230	Xylene (total)	NP	0.002	0.002	0.002	0.002	0.002	0.002

NP - Not present above the detection limit.
Sources: USEPA 1987c, USEPA 1988g, USEPA 1988h, USEPA 1988p.

Appendix A (continued)

Waste code	Constituent	Concentration of constituent in untreated K and F waste (ppm)	Detection limits (ppm) K022 Sample 1	Sample 2	Sample 3	Sample 4	Sample 5	Sample 6
U019	Benzene	Untreated data is CBI	NO WASTEWATER DATA					
U220	Toluene							
U230	Xylene (total)							

Waste code	Constituent	Concentration of constituent in untreated K and F waste (ppm)	Detection limits (ppm) K024 Sample 1	Sample 2	Sample 3	Sample 4	Sample 5	Sample 6	Sample 7	Sample 8	Sample 9	Sample 10
U019	Benzene	NP	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002
U220	Toluene	NP	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002
U230	Xylene (total)	NP	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002

Waste code	Constituent	Concentration of constituent in untreated K and F waste (ppm)	Detection limits (ppm) K037 Sample 1	Sample 2	Sample 3	Sample 4	Sample 5	Sample 6	Sample 7	Sample 8
U019	Benzene	NP	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002
U220	Toluene	201-2,000	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002
U230	Xylene (total)	NP	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002

NP - Not present above the detection limit.

Sources: USEPA 1987a, USEPA 1988a, USEPA 1988b, USEPA 1988i.

Appendix A (continued)

Waste code	Constituent	Concentration of constituent in untreated K and F waste (ppm)	Detection limits (ppm) K048/K051 Sample 1	Sample 2	Sample 3	Sample 4	Sample 5	Sample 6
U019	Benzene	NP	0.0041	0.0041	0.0041	0.0041	0.0041	0.0041
U220	Toluene	22-120	0.0040	0.0040	0.0040	0.0040	0.0040	0.0040
U230	Xylene (total)	<14-120	0.0040	0.0040	0.0040	0.0040	0.0040	0.0040

Waste code	Constituent	Concentration of constituent in untreated K and F waste (ppm)	Detection limits (ppm) K086 Sample 1	Sample 2	Sample 3	Sample 4	Sample 5	Sample 6
U019	Benzene		0.010	0.005	0.005	0.005	0.005	0.005
U220	Toluene		0.010	0.005	0.005	0.005	0.005	0.005
U230	Xylene (total)		0.005	0.005	0.005	0.005	0.005	0.005

Waste code	Constituent	Concentration of constituent in untreated K and F waste (ppm)	Detection limits (ppm) K087 Sample 1	Sample 2	Sample 3	Sample 4	Sample 5
U019	Benzene	5.6-212	0.005	0.005	0.005	0.005	0.005
U220	Toluene	5.0-152	0.005	0.005	0.005	0.005	0.005
U230	Xylene (total)	3.0-123	0.005	0.005	0.005	0.005	0.005

NP - Not present above the detection limit.
Sources: USEPA 1986b, USEPA 1986c, USEPA 1987d, USEPA 1987e, USEPA 1988c, USEPA 1988j, USEPA 1988k.

Appendix A (continued)

Waste code	Constituent	Concentration of constituent in untreated K and F waste (ppm)	Detection limits (ppm) K101 Sample 1	Sample 2	Sample 3	Sample 4
U019	Benzene	NP	0.005	0.005	0.005	0.005
U220	Toluene	<25-42	0.005	0.005	0.005	0.005
U230	Xylene (total)	NP	0.005	0.005	0.005	0.005

Waste code	Constituent	Concentration of constituent in untreated K and F waste (ppm)	Detection limits (ppm) K102 Sample 1	Sample 2	Sample 3	Sample 4	Sample 5	Sample 6
U019	Benzene	NP	0.005	0.005	0.005	0.005	0.005	0.005
U220	Toluene	NP	0.005	0.005	0.005	0.005	0.005	0.005
U230	Xylene (total)	<1.5-5.3	0.005	0.005	0.005	0.005	0.005	0.005

Waste code	Constituent	Concentration of constituent in untreated K and F waste (ppm) Test 1	Test 2	Detection limits (ppm) June 1989 John Zink Pesticides Test Burn Test 2 Sample 1	Sample 2	Sample 3	Sample 4	Test 2 Sample 1	Sample 2	Sample 3	Sample 4
U019	Benzene	NP	NP	ND	ND	ND	ND	ND	ND	ND	ND
U220	Toluene	69,000	<0.010-<6,300	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005
U230	Xylene (total)	NP	NP	ND	ND	ND	ND	ND	ND	ND	ND

ND - No data available.
NP - Not present above the detection limit.
Sources: USEPA 1988d, USEPA 1988e, USEPA 1988m, USEPA 1988n.

APPENDIX B

Matrix Spike Recoveries for Kiln Ash Residue and
Combustion Gas Scrubber Discharge Water for
K001 Pentachlorophenol and Creosote

(All recovery values above 100 percent were considered as just 100 percent)

K001 Creosote Ash Sample ZK01C-3-B2
VOA Matrix Spike Recoveries (%)

	Spike Level (ug/L)	S710125 ZK01C-3-B2 #1	#2	RPD
1,1-Dichloroethene	25	86	95	9.9
Toluene	25	99	110 [a]	10
Chlorobenzene	25	102 [a]	112 [a]	9.3
Benzene	25	78	88	12
Trichlorethylene	25	67	77	14
Average percent recovery		86	92	

K001 Creosote Water Sample ZK01C-3-B2
VOA Matrix Spike Recoveries (%)

	Spike Level (ug/L)	S710125 ZK01C-3-B2 #1	#2	RPD
1,1-Dichloroethene	25	100 [a]	97	3.0
Toluene	25	103 [a]	99	4.0
Chlorobenzene	25	95	90	5.4
Benzene	25	90	85	5.7
Trichlorethylene	25	69	64	7.5
Average percent recovery		90.8	87	

[a]Recovery values greater than 100 percent are considered as just 100 percent in calculating the average percent recovery.

Source: USEPA 1987b.

K001-PCP Ash Duplicate Matrix Spike Data,
Volatile Organic Analysis

Compound	Original amount present, µg/liter	Amount spiked, µg/liter	Amount recovered, µg/liter		% Recovery	
			No. 1	No. 2	No. 1	No. 2
Toluene	3	25	30	30	108 [b]	108 [b]
Chlorobenzene	<2	25	31	30	124 [b]	120 [b]
Benzene	<2	25	22	22	88	88
Trichloroethene	<2	25	22	21	88	84
Average percent recovery					94	93

K001-PCP Scrubber Water Duplicate Matrix Spike Data
Volatile Organic Analysis

Compound	Original amount present, µg/liter	Amount spiked, µg/liter	Amount recovered, µg/liter		% Recovery	
			No. 1	No. 2	No. 1	No. 2
1,1-Dichloroethylene	<2	25	23	28	92	112 [b]
Toluene	<2	25	30	30	120 [b]	120 [b]
Chlorobenzene	<2	25	30	26	120 [b]	104 [b]
Benzene	<2	25	23	30	92	120 [b]
Trichloroethene	<2	25	21	21	84	84
Average percent recovery					93.6	96.8

Source:

K001 Creosote Ash Sample Semivolatile
Organics Matrix Spike Recoveries (%)

Compound	Initial conc. (ug/g)	Amount added (ug/g)	% Recovery #1	% Recovery #2	RPD
Acid-Extractables					
Phenol	<4	67	72	65	9.7
2-Chlorophenol	<4	67	59	53	10
4-Chloro-3-methylphenol	<4	67	35	68	48
4-Nitrophenol	<20	67	1.2[a]	2.6[a]	54
Pentachlorophenol	<20	67	0[a]	0[a]	NC
Base/Neutral Extractables					
1,4-Dichlorobenzene	<4	33	48	46	4.2
N-nitroso-di-n-propylamine	<4	33	67	62	7.5
1,2,4-Trichlorobenzene	<4	33	30	30	0
Acenaphthene	<4	33	0[a]	3.4[a]	100
2,4-Dinitrotoluene	<4	33	0[a]	0[a]	NC
Pyrene	<4	33	0[a]	0[a]	NC
Percent average of recoveries			48.3	46	

NC - Not calculated.

[a]Recovery values below 20 percent were not considered in determining the average percent recovery.

Source: USEPA 1987b.

K001 Creosote Water Sample Semivolatile
Organic Matrix Spike Recoveries (%)

Compound	Initial conc. (ug/l)	Amount added (ug/l)	% Recovery #1	% Recovery #2	RPD
Acid Extractables					
Phenol	<10	100	65	61	6
2-Chlorophenol	<10	100	61	65	6
4-Chloro-3-methylphenol	<10	100	80	73	9
4-Nitrophenol	<50	100	0[a]	0[a]	NC
Pentachlorophenol	<50	100	80	85	6
Base/Neutral Extractables					
1,4-Dichlorobenzene	<10	50	61	51	16
N-nitroso-di-n-propylamine	<100	50	70	56	20
1,2,4-Trichlorobenzene	<10	50	72	54	25
Acenaphthene	<10	50	81	66	19
2,4-Dinitrotoluene	<10	50	21	17[a]	19
Pyrene	<10	50	62	60	3
Percent average of recoveries			61.2	57.4	

NC - Not calculated.

[a]Recovery values below 20 percent were not considered in determining the average percent recovery.

Source: USEPA 1987b.